

Appendix F
GUIDE SPECIFICATION

FOR

PHOTOGRAMMETRIC MAPPING AND AERIAL PHOTOGRAPHY SERVICES

INSTRUCTIONS

1. General. This guide specification is intended for use in preparing Architect-Engineer (A-E) contracts for professional photogrammetric mapping services. These specifications are applicable to all A-E contracts used to support US Army Corps of Engineers (USACE) civil works and military construction design, construction, operations, maintenance, regulatory, and real estate activities. This guide shall be used primarily for contracts obtained using Public Law (PL) 92-582 (Brooks Act) qualification-based selection procedures and for which unit prices in the contract schedule are negotiated. Limited exceptions to this contracting method are identified herein. This guide supersedes and combines CE 1103, "Photogrammetric Mapping and Complementary Field Surveys," dated November 1965, and CE 1104, "Aerial Photography for Photogrammetric Mapping, Photo Maps and Mosaics," dated March 1966.

2. Coverage. This guide specification contains the technical standards and/or references necessary to specify all phases of a photogrammetric mapping project. These include aircraft operations; aerial cameras; aerial mapping film and film processing; photographic prints and film enlargements; photogrammetric rectification and stereocompilation; map planimetric feature and topographic detailing; drafting; digital mapping; generation of Computer-Aided Drafting and Design (CADD) system, Geographic Information System (GIS), Land Information System (LIS), Automated Mapping/Facility Management (AM/FM), and other spatial databases; ground survey control support; supplemental ground topographic survey densification; and contractor quality control functions.

3. Applicability. The following types of A-E contract actions are supported by these instructions:

a. Fixed-price photogrammetric mapping and aerial photography service contracts.

b. Indefinite delivery type (IDT) photogrammetric mapping contracts.

c. A multidiscipline surveying and mapping IDT contract in which photogrammetric services are a line item supporting other surveying, mapping, hydrography, and/or other surveying services.

d. A work order or delivery order placed against an IDT contract.

e. Design and design-construct contracts that include incidental surveying and mapping services (including Title II services). Both fixed-price and IDT design contracts are supported by these instructions.

4. Contract Format. The contract format outlined in this guide follows that prescribed in Appendix B of Principal Assistant Responsible for Contracting

Instruction Letter 92-4 (PARC IL 94-4), dated 18 December 1992. PARC IL 92-4 incorporates changes to Part 14.201(a)(1) of the 1989 edition of the Engineer Federal Acquisition Regulation Supplement (EFARS). The PARC IL 92-4 contract format is designed to support PL 92-582 (Standard Form (SF) 252) qualification-based A-E procurement actions.

5. Photogrammetric Line Mapping Applications. This guide is intended primarily to support complete, field-to-finish type contracts written for large-scale (1 in. = 400 ft or greater) site plan mapping work, as would be used for design and subsequent contracted construction plans and specifications. Typical applications include building or structure design or relocation; river, harbor, floodplain, or reservoir project mapping; and installation master planning activities. Both planimetric feature detail and topographic data are generated or encoded using high-precision stereoscopic plotting instruments (or orthophoto scanning instruments). Specifying field-to-finish implies that all phases of the photogrammetric process, from aerial photography through final drafting, are performed by the professional contractor. In addition, the contractor is responsible for exercising complete quality control over all phases of the work.

6. Supplemental Aerial Photo Products. This guide may also be used to specify other associated photographic products commonly used in USACE design, planning, construction, and regulatory enforcement work. Requirements for these products would be included as supplemental line items in a professional A-E services contract intended for design mapping.

a. Air Photo Plan Drawings. These are typically film-positive screened transparencies on standard drawing film format developed from enlarged aerial photos. They are often used for construction location reference drawings or navigation project condition reports. Since they do not have a consistent scale, they should not be used for detailed design.

b. Aerial Photography. These include standard 9- by 9-in. aerial photographs using precision aerial mapping cameras. Such photography may be intended for subsequent line mapping compilation by either USACE hired-labor forces or another A-E contractor. Alternatively, it may be intended only for regulatory enforcement or environmental interpretative purposes, or for general reconnaissance photography of a large region. Composite paper mosaics may be constructed from this photography. Either black and white, color, or infrared photography might be specified.

c. Photographic Enlargements. Aerial photo paper enlargements, either from near-vertical or oblique photography, may or may not be obtained from high-precision aerial mapping cameras. These products are normally used for display or general planning purposes.

The distinguishing factor about these supplemental items is that they are generally uncontrolled products; i.e., the photography is not converted into a base map or photograph free from scale error or relief displacement. Although these items may be included in an A-E IDT contract, they may also be procured using price competition methods, as explained in paragraph 7 below.

7. Aerial Photography Procurement Using Other than A-E Forms. This guide is also designed to support procurement of basic aerial photography by methods

other than A-E service contracts. Part 36 of the EFARS prescribes that basic aerial photography may be obtained by price competition, where award is based primarily on price (i.e., low-bid), and not using professional/technical qualification-based selection criteria. This EFARS provision strictly pertains to contracting for aerial photography and delivery of raw photographic negatives or positives to the Government.

a. Strictly price-competitive (i.e., low-bid) procurement shall not be used if the photography is an integral part of a broader scoped contract that results in a map product, or if photogrammetric mensurations, mapping, rectifications, or any like realignment or rescaling is to be performed on the photography. Price-competitive procurement shall also not be used if photographic spatial data are input to any type of GIS, CADD system, LIS, or any other similar database that develops vector or raster/coordinate relationships or attributes. In all such instances, PL 92-582 qualification-based selection procedures must be used.

b. Some USACE photographic (not photogrammetric) needs may be procured using price competition methods. However, the following factors must be fully considered by USACE Commands in determining whether to use price competition or PL 92-582 methods:

(1) Price-competitive (low-bid) procurement methods may be applicable to aerial photography used for photo interpretative work, such as regulatory enforcement, where the 9- by 9-in. prints can be used as is. No subsequent mapping is intended from such photography.

(2) When aerial photography is to be compiled into line maps by a party other than the firm that flew it, a certain amount of quality control is lost over the process. Inadequacies in the photography may not be detected until stereocompilation commences, which may occur long after the aerial photography contract has been closed out. Likewise, photo control field surveys are best performed under the direct supervision and control of the firm responsible for compilation. Unless there are other compelling reasons (e.g., in-house stereocompilation), full field-to-finish mapping should be performed by the same contractor using PL 92-582 procurement. Use of low-bid procurement methods to obtain the aerial photography, and then passing such photography to another photogrammetric mapping firm for compilation, is a practice (or procurement strategy) that should be avoided if at all possible.

(3) Price-competitive procurement methods require exacting specifications and more rigorous Government quality control. Experienced in-house personnel must be capable of assessing photographic quality, coverage, and suitability for subsequent aerotriangulation and stereocompilation. Unless such activities are routinely performed within the USACE Command, evaluating contract performance is marginal, at best.

(4) When only small-scale, reconnaissance-type photography is required over a large area (e.g., an installation, watershed basin, or state), a price-competitive low-bid procurement action would be recommended.

(5) Air photo paper enlargements of a small, specific site may often be obtained by simple purchase order.

(6) Use of strictly price-competitive IDT contracts is not recommended.

c. USACE Commands must ultimately assess the project requirements, along with their in-house quality control capabilities, in deciding between the two forms of contracting. As a general rule of thumb, if the photographic products are to be used for construction contract plans and specifications, reproducible project condition drawings, boundary delineation or demarcation, or environmental/regulatory assessment or litigation, or will be encoded into some type of GIS, LIS, AM/FM, or CADD spatial database, the recommended method is to follow PL 92-582 qualification-based procurement methods.

8. General Guide Use. In adapting this guide specification to any project, specific requirements will be changed as necessary for the work contemplated. Changes will be made by deletions or insertions within this format. With appropriate adaptation, this guide form may also be tailored for direct input in the Standard Army Automated Contracting System (SAACONS). Clauses and/or provisions shown in this guide will be renumbered during SAACONS input.

9. Guide Arrangement. The work items listed in the Section B price schedule and Section C technical specifications are in the general order of performance on a typical photogrammetric mapping project. Scheduled line items in Section B follow the same general sequence as major paragraphs in Section C.

10. Insertion of Technical Specifications. Engineer Manual (EM) 1110-1-1000, Photogrammetric Mapping, should be attached to and made part of any contract for aerial photography or photogrammetric mapping services. This EM contains specifications and quality control criteria for the total (field-to-finish) execution of a photogrammetric mapping project.

a. The latest edition of the American Society for Photogrammetry and Remote Sensing's (ASPRS) Manual of Photogrammetry should also be attached by reference to any contract. This manual represents a comprehensive treatment of aerial photography and photogrammetric mapping, and should be deferred to in cases of disputes over quality of services delivered.

b. Technical specifications for photogrammetric mapping that are specific to the project (including items such as the scope of work, procedural requirements, and accuracy requirements) will be placed under Section C of the SF 252 (Block 10). The prescribed format for placing these technical specifications is contained in this guide. Project-specific technical specifications shall not contain contract administrative functions—these should be placed in more appropriate sections of the contract.

c. Technical specifications for other survey functions required in a photogrammetric mapping services contract may be developed from other Civil Works Construction Guide Specifications that are applicable to the surveying and mapping discipline(s) required.

d. Standards and other specifications should be checked for obsolescence and for dates and applicability of amendments and revisions issued subsequent to the publication of this specification. Use Engineer Pamphlet (EP) 25-1-1, Index of USACE/OCE Publications. Maximum use should be

made of existing EM's, Technical Manuals, and other recognized or current industry standards and specifications.

e. Many technical provisions in this guide have incorporated both traditional and automated stereoplotting and compilation methods. The on-going developments and refinements in automated analytical stereoplotters, digital photography, CADD, etc., require the guide user to ensure that redundant, obsolete, or inefficient procedures in this guide are continuously updated.

11. Cost Estimates for Photogrammetric Mapping Services. General guidance on preparing independent Government cost estimates is contained in Chapter 11 of EM 1110-1-1000. The unit of measure (lump sum/job or labor interval) shown in Section B will be highly project dependent. Given the nonlinearity of many of these services, fixed unit prices in an IDT contract may be difficult to establish. In some instances, a work order placed against an IDT contract may require adjustments for services not contemplated in the initial base contract.

13. Alternate Clauses/Provisions or Options. In order to distinguish between required clauses and optional clauses, required clauses are generally shown in capital letters. Optional or selective clauses are generally in lower case. In other instances, alternate clauses/provisions may be indicated by brackets "[]" and/or clauses preceded by a single asterisk "*". A single asterisk signifies that a clause or provision that is inapplicable to the particular section may be omitted, or that a choice of clauses may be made depending upon the technical surveying and mapping requirement. Clauses requiring insertion of descriptive material or additional project-specific specifications are indicated by underlining inside brackets (e.g., "[_____]"). In many instances, explanatory notes are included regarding the selection of alternate clauses or provisions.

13. Notes and Comments. General comments and instructions used in this guide are contained in blocked asterisks. These comments and instructions should be removed from the final contract.

14. Indefinite Delivery Type (IDT) Contracts and Individual Work Order Assignments. Contract clauses pertaining to IDT contracts, or delivery orders thereto, are generally indicated by notes adjacent to the provision. These clauses should be deleted for fixed-price contracts. In general, sections dealing with IDT contracts are supplemented with appropriate comments pertaining to their use. Work orders against a basic IDT contract should be constructed using the general format contained in Section C of this guide. Clauses contained in the basic contract should not be repeated in work orders. Contract Section C in this guide is applicable to any type of photogrammetric mapping service contracting action.

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SECTION A

SOLICITATION/CONTRACT FORM

NOTE: Include here SF 252 in accordance with the instructions in Appendix B of PARC IL 92-4.

SF 252 -- (Block 5): PROJECT TITLE AND LOCATION

NOTE: Sample title for fixed-price contract:

PHOTOGRAMMETRIC SITE PLAN MAPPING SURVEYS IN SUPPORT OF PRELIMINARY CONCEPT DESIGN OF FAMILY HOUSING COMPLEX ALPHA, AND RELATED INSTALLATION MASTER PLANNING GEOGRAPHIC INFORMATION SYSTEM DATA BASE UPDATES, AT FORT _____, ALABAMA.

PHOTOGRAMMETRIC SITE PLAN MAPPING, SEMI-CONTROLLED AIR PHOTO PLAN DRAWINGS, AND AERIAL PHOTO ENLARGEMENTS FOR DREDGE DISPOSAL DESIGN, CONSTRUCTION, AND BOUNDARY DEMARCATION, OF _____ [PROJECT], _____, CALIFORNIA.

NOTE: Sample title for indefinite delivery type contract:

INDEFINITE DELIVERY CONTRACT FOR PROFESSIONAL PHOTOGRAMMETRIC MAPPING, AND RELATED SURVEYING SERVICES, IN SUPPORT OF VARIOUS *[CIVIL WORKS] [MILITARY CONSTRUCTION] PROJECTS *[IN] [ASSIGNED TO] THE _____ DISTRICT.

NOTE: When other surveying services are also required as part of a broader surveying contract, the clause shown in EAL 90-1 shall be used.

SECTION B

SERVICES AND PRICES/COSTS

NOTE: The fee schedule for photogrammetric mapping and related survey services should be developed in conjunction with the preparation of the independent Government estimate (IGE) along with the technical specifications. Two general unit of measure (U/M) methods may be used in a fee schedule for photogrammetric mapping services: (1) an

Hourly or Daily Rate basis or (2) a Cost per Unit Area basis.

The following tables contain sample fee schedules that may be tailored for use on most photogrammetric mapping service contracts. The guide writer should select those line items applicable to the project, or for those projects envisioned over the course of an IDT contract. Other line items may be added that are unique to the project(s). If applicable, a separate fee schedule for contract option periods should be developed and negotiated during contract negotiations and included with the contract during initial award. Unit prices (U/P) shall include direct and indirect overheads. Profit is not included on IDT contract unit prices.

Procedures for estimating line item unit prices are described in EM 1110-1-1000. Determination of these estimated unit prices must conform to the detailed analysis method, or "seven-item breakdown." The scope of each scheduled line item used in Section B must be thoroughly defined--either with the line item in Section B or at its corresponding reference in Section C of the contract. Many of the line item units of measure comprise costs from a variety of sources. These sources are combined in the IGE to arrive at the scheduled rate. For example, aircraft operation, maintenance, and labor costs are reduced to a cost per flight hour. Survey crew day rates include labor, travel, transportation, expendable materials, and numerous other items that are developed as part of the IGE.

On IDT contracts, the specification writer should strive to avoid scheduling items with little probability of being required during the contract period. Since each line item must be separately estimated and negotiated, considerable Government (and contractor) resources may be consumed in developing negotiated unit costs for unused items. For example, line items such as orthophoto map compilation or infrared photography would not be included on an IDT contract unless there is a fair degree of assurance that these items would be required on a subsequent work order.

In addition, the specification writer should attempt to include only those line items that represent a major cost activity/phase in performing photogrammetric mapping. Cost estimating emphasis and resources should be committed to major cost items such as stereocompilation, control surveys, drafting, and aerial photography, and in that order. Avoid cluttering the schedule with small and relatively insignificant (to the overall project cost) supply and material items, again minimizing the administrative costs of estimating and negotiating these items. These should be included as part of a major line item or

be contained in the firm's overhead. Examples of normal supply items that the guide user should avoid scheduling are field survey books or bundles of 2- by 2-in. survey stakes. These items would, however, be compensated for in the IGE. Care must be taken in developing these schedules with the IGE to preclude duplication of costs between line items or overheads. This is particularly important when breaking out analytical stereoplotter costs with associated computer and CADD actions. The guide user and cost estimator must have a good working knowledge of photogrammetric mapping production processes to properly allocate time and costs.

The following schedules may be tailored for either A-E fixed-price or A-E IDT contracts. For fixed-price contracts, the estimated quantities are available from the government estimate. For IDT contracts, a unit quantity for each line item would be negotiated and included in the basic contract. Daily units of measure may be modified to hourly or other nominal units if needed. Lump sum or areal units of measure are also included or may be developed for some of the services. For non-A-E type contracts for photography, the schedule would have to be modified for bid submittal. The item numbers shown are for reference in this guide only--they would be renumbered in the final contract.

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
0500	<p>AIRCRAFT FLIGHT OPERATIONS: AIRCRAFT OWNERSHIP, OPERATION, AND MAINTENANCE COSTS; CAMERA; PILOT; CAMERAMAN; FUEL; LANDING FEES; ETC., BASED ON ACCUMULATED FLIGHT TIME BETWEEN CONTRACTOR'S HOME BASE/AIRFIELD TO PROJECT SITE, BETWEEN PROJECT SITES, AND/OR TEMPORARY LANDING FIELDS NEAR PROJECT SITES (IF APPLICABLE), OVER PROJECT SITE(S), AND RETURN TO HOME BASE/AIRFIELD. *[A MINIMUM TRANSIT TIME OF 2.5 *[_] HOURS WILL BE APPLICABLE TO EACH DELIVERY ORDER, UNLESS WAIVED BY THE CONTRACTOR.]</p> <p>{NOTE: Negotiated hourly rate is determined primarily from field pricing support audit of firm's aircraft operating costs.}</p>		FLIGHT HOUR		
0501	<p>* ADDITIONAL AIRCRAFT FLIGHT CREW COSTS: FLIGHT CREW AND CAMERAMAN LABOR AND PER DIEM ON TEMPORARY DUTY AT PROJECT SITE.</p> <p>{NOTE: This line item is included only when a unique project scope, size, or location requires the aircraft and crew to temporarily locate at the project site. Normal standby time at the home base is not included in this item; it is more properly included in the firm's overhead.}</p>		C/DAY		
0502	<p>* EMERGENCY AIRCRAFT AND FLIGHT CREW STANDBY: SURCHARGE COST OF AIRCRAFT AND CREW FOR DEDICATING OPERATIONS EXCLUSIVELY TO GOVERNMENT-DIRECTED WORK; DURING EMERGENCY OPERATION PERIODS.</p> <p>{NOTE: Include on IDT contracts as applicable. U/P is essentially firm's overhead rate for aircraft and crew while on nonflight status.}</p>		C/DAY		
0503	<p>* AIRCRAFT AND FLIGHT CREW SURCHARGE FOR *[OCONUS] [_] TRANSIT, TRAVEL, AND RELATED NONSTANDARD FEES AND EXPENSES ASSOCIATED THEREWITH.</p>		JOB	L/S	

Note: AMT = Amount; C/DAY = Crew-Day; L/S = Lump Sum; EXP = Exposure; M/DAY = Man-Day; M/HOUR = Man-Hour.

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
0503 (Continued)	{NOTE: Use, as applicable, for either nonconventional or OCONUS (outside the continental United States) sites and/or projects. Fee is in addition to those routinely covered above, and could include items such as aircraft long-distance transit modifications, customs fees, fuel surcharges, OCONUS per diem, etc.}				
0504	*[other requirements]				
	<p>AERIAL PHOTOGRAPHY: OBTAIN STEREOSCOPIC COVERAGE *[BLACK AND WHITE PANCHROMATIC] [COLOR] [_____] PHOTOGRAPHY USING HIGH-PRECISION AERIAL MAPPING CAMERA IN ACCORDANCE WITH SCALE, COVERAGE, AND OTHER APPLICABLE TECHNICAL SPECIFICATIONS CONTAINED IN SECTION C *[AND/OR DELIVERY ORDER SCOPE], AND MAPS OR ATTACHMENTS THERETO; AND PERFORM ALL PROFESSIONAL LABORATORY FILM PROCESSING AND PREPARATION FUNCTIONS, TO INCLUDE LABOR AND MATERIALS FOR DEVELOPING, TRIMMING, CLEANING, INDEXING, LABELING, AND SHIPPING OF NEGATIVES AND POSITIVES.</p> <p>AERIAL PHOTOGRAPHY SHALL BE FLOWN WITH A 6-IN. CAMERA AT AN ALTITUDE THAT RESULTS IN A NEGATIVE SCALE *[OF_____] [INDICATED IN SECTION C].</p> <p>{NOTE: For IDT contracts, add the following statement: The contractor may waive this minimum order if he is able to consume a roll of film over several projects.}</p> <p>* A MINIMUM DELIVERY OF THIRTY (30) *[_____] (____) EXPOSURES WILL APPLY TO EACH ORDER PLACED AGAINST THIS CONTRACT, UNLESS WAIVED BY THE CONTRACTOR.</p> <p>FURNISH *[ONE (1)] [_____] (____) SET(S) OF PRELIMINARY CHECK PRINTS AND *[TWO (2)] [_____] (____) SETS OF FINAL CONTACT PRINTS FOR EACH EXPOSURE. {NOTE: Add control prints if needed.}</p>				

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
(Continued)	{NOTE: Specify only those film types below that will be used on the project and/or IDT contract. Detailed material and technical specifications for each film type specified must be included in Section C of the contract.}				
0800	* BLACK AND WHITE PANCHROMATIC FILM		EXP		
0801	* COLOR AERIAL FILM		EXP		
0802	* COLOR INFRARED FILM (FALSE COLOR)		EXP		
0803	* [OTHER] {NOTE: Add material/ technical requirements at Section C}		EXP		
0900	* ADDITIONAL CONTACT PRINTS {NOTE: This item may be scheduled on IDT contracts if there is a possibility that additional contact prints (beyond the required delivery amount} may be required on one or more orders. Include a line item for each type of film scheduled above.}		EACH		
0901	FILM DIAPOSITIVES: BLACK AND WHITE FILM TRANSPARENCIES COLOR FILM TRANSPARENCIES *[GLASS DIAPOSITIVES]		EACH EACH EACH		
0902	* OBTAIN NEAR-VERTICAL AND/OR OBLIQUE AERIAL PHOTOGRAPHY FOR *[CONTROLLED MAPPING] [GENERAL UNCONTROLLED PHOTO ENLARGEMENT] USES, USING *[AERIAL MAPPING CAMERA] [HAND-HELD CAMERA] AND IN ACCORDANCE WITH SECTION C SPECIFICATIONS.		JOB		
0903	*[other requirements]				
	PHOTO INDEX: PROFESSIONAL LABOR AND MATERIALS REQUIRED TO PREPARE STANDARD PHOTO INDICES IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS, SHEET TYPE/SIZE, SCALES, ETC., AS DESCRIBED IN SECTION C OF THE CONTRACT *[AND/OR AS MODIFIED BY DELIVERY ORDERS]; PROCESS/PRINT RATIOED CONTACT PRINTS; LAY OUT, INDEX, AND ORIENT FLIGHT STRIPS; AND DRAFTING AND REPRODUCTION OF INDICES. DELIVER *[ONE (1)] *[____ (____)] SET OF PHOTO INDEX MAPS PER PROJECT ON MATERIAL/FORMAT DESCRIBED IN SECTION C.		EACH INDEX SHEET	L/S	

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
1000 (Con- tin- ued	{NOTE: On IDT contracts, the U/M should be based on a nominal 20- by 24-in. index sheet with the negotiated U/P developed from a typical number of photos/flight strips.}				
1001	LINE PHOTO INDEX MAP: DELIVER *[ONE (1)] *[_ ()] SET OF LINE PHOTO INDEX MAPS PER PROJECT ON USGS QUAD MAP, IN FORMAT DESCRIBED IN SECTION C.		EACH	L/S	
	<p>UNCONTROLLED PHOTOGRAPHIC PRODUCTS: FOR EACH PRODUCT LISTED BELOW, PROVIDE NECESSARY LABOR AND MATERIALS REQUIRED, TO INCLUDE THE FOLLOWING: LABORATORY FILM PROCESSING AND PREPARATION FUNCTIONS, PHOTOGRAPHIC ENLARGEMENT FUNCTIONS, TRIMMING, ORIENTATION, INDEXING, LABELING, MOUNTING, DRAFTING, REPRODUCTION, AND SHIPPING OF RESULTANT NEGATIVE AND/OR POSITIVE DRAWINGS/TRANSPARENCIES, AS APPLICABLE TO THE PRODUCT AND AS DEFINED IN SECTION C OF THE CONTRACT SCOPE OF WORK. FURNISH [ONE (1)] *[_ ()] SET OF EACH REQUIRED PRODUCT, MOUNTED ON *[MASONITE] [STYROFOAM] [PLYWOOD] [____], OR ON FILM POSITIVE TRANSPARENCIES AS SPECIFIED IN SECTION C.</p> <p>{NOTE: Specify photo mounting and framing, as applicable, or requirements for reproducible film positives or film negatives, unless covered in Section C.}</p> <p>{NOTE: Select only the following items applicable to the contract.}</p>				
1100	AIR PHOTO ENLARGEMENT, BLACK & WHITE, PER SECTION C ENLARGEMENT CRITERIA.		*[JOB] [SQ IN]		
1101	AIR PHOTO ENLARGEMENT, COLOR, PER SECTION C ENLARGEMENT CRITERIA.		*[JOB] [SQ IN]		
1102	UNCONTROLLED AIR PHOTO PLAN ENLARGEMENT, BLACK AND WHITE, FILM POSITIVE DRAWING FORMAT, PER SECTION C SPECIFICATIONS.		*[JOB] [SQ IN] [SQ FT]		
1103	AIR PHOTO MOSAIC, ASSEMBLED FROM UNCONTROLLED PHOTOGRAPHY.		[JOB]		
1104	*[other requirements]				

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
	<p>SEMICONROLLED AIR PHOTO PLANS, CONTROLLED AIR PHOTO PLANS, AND ORTHOPHOTO PRODUCTS: FOR EACH PRODUCT LISTED BELOW, PROVIDE NECESSARY LABOR AND MATERIALS REQUIRED, TO INCLUDE THE FOLLOWING: LABORATORY FILM PROCESSING AND PREPARATION FUNCTIONS, PHOTOGRAPHIC ENLARGEMENT FUNCTIONS, PHOTO CONTROL RECTIFICATION, MENSURATION AND HORIZONTAL/VERTICAL ORIENTATION AND ALIGNMENT, TRIMMING, INDEXING, LABELING, MOUNTING, DRAFTING, REPRODUCTION, AND SHIPPING OF RESULTANT NEGATIVE AND/OR POSITIVE DRAWINGS/TRANSPARENCIES, AS APPLICABLE TO THE PRODUCT AND AS DEFINED IN SECTION C OF THE CONTRACT SCOPE OF WORK. FURNISH [ONE (1)] *[_ ()] SET OF EACH REQUIRED PRODUCT IN THE FORMAT SPECIFIED IN SECTION C.</p> <p>{NOTE: Specify, for each line item, sheet size, photo mounting and framing, and other applicable requirements, including requirements for reproducible film positives or film negatives. These detailed specifications may be contained in Section C.}</p> <p>{NOTE: Select only the following items applicable to the contract.}</p>				
1200	SEMICONROLLED (TO USGS MAP BASE) AIR PHOTO PLAN ENLARGEMENT, *[BLACK & WHITE] [COLOR], ON FILM-POSITIVE DRAWING FORMAT		[SHEET] or [JOB]		
1201	CONTROLLED/RECTIFIED AIR PHOTO PLAN ENLARGEMENT, *[BLACK & WHITE] [COLOR], ON FILM-POSITIVE DRAWING FORMAT		[SHEET] or [JOB]		
1205	<p>ORTHOPHOTOGRAPH, BLACK AND WHITE, FILM-POSITIVE DRAWING FORMAT.</p> <p>{NOTE: Topo or feature overlay requirements would be covered by stereoplotter line items, as would ground survey control needs.}</p>		JOB	L/S	
1210	*[other requirements]				
1300	REGISTERED/LICENSED LAND SURVEYOR		M/DAY		
1301	SURVEY COMPUTER (OFFICE)		M/DAY		

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
1302	[TWO][THREE][FOUR][____]-MAN PHOTO CONTROL SURVEY PARTY, CONSISTING OF ALL LABOR, TRAVEL, TRANSPORTATION, SURVEY EQUIPMENT, AND MATERIALS NECESSARY TO PERFORM PHOTO CONTROL SURVEYS, INCLUDING PANELLING, QUALITY CONTROL, AND TOPOGRAPHIC DETAILING, AND OTHER FUNCTIONS SPECIFIED IN SECTION C.		C/DAY		
	{Unit rates for individual party members}				
1303	SUPERVISORY SURVEY TECHNICIAN (FIELD)		M/DAY		
1304	SURVEYING TECHNICIAN-INSTRUMENTMAN/RECORDER		M/DAY		
1305	SURVEYING AID-RODMAN/CHAINMAN		M/DAY		
1306	STATION MONUMENTS {NOTE: Specify disc type and monument construction}		EACH		
1307	FIELD CLASSIFICATION, QUALITY CONTROL, AND EDIT SURVEYS: *[TWO] [____]-MAN SURVEY CREW (SUP SURV TECH + INST/REC)		C/DAY		
1308	FIELD QUALITY ASSURANCE MAP TESTING SURVEYS: *[TWO] [____]-MAN CREW (SUP SURV TECH + INST/REC)		C/DAY		
	STEREOCOMPILATION, DRAFTING, AND EDITING: FURNISH PROFESSIONAL LABOR, INSTRUMENTATION, AND MATERIALS REQUIRED TO ORIENT, CONTROL, AND MAP TOPOGRAPHIC AND/OR PLANIMETRIC FEATURES USING STEREOSCOPIC PLOTTING INSTRUMENTS; SCRIBE, DRAFT, EDIT FINAL DRAWINGS; AND DEVELOP DIGITAL DATABASES IN ACCORDANCE WITH THE PROJECT TECHNICAL AND ACCURACY REQUIREMENTS SPECIFIED IN SECTION C OF THE CONTRACT.				
1400	MODEL SETUP AND ORIENTATION		M/HOUR		
1401	PLANIMETRIC FEATURE STEREOCOMPILATION		M/HOUR		
1402	TOPOGRAPHY STEREOCOMPILATION {NOTE: The above items may be combined}		M/HOUR		
1403	ANALYTICAL AEROTRIANGULATION: LABOR, MATERIALS, AND MEASUREMENT/COMPUTATION INSTRUMENTS NECESSARY TO MEASURE AND ADJUST SUPPLEMENTAL PHOTO CONTROL USING ANALYTICAL BRIDGING TECHNIQUES.		PHOTO or PLATE MODEL		
	DRAFTING MATERIALS AND LABOR:				

ITEM	DESCRIPTION	QUAN	U/M	U/P	AMT
1404	STABLE-BASED MYLAR *[F-SIZE]		SHEET		
1405	SCRIBECOAT MATERIAL		SHEET		
1406	PLANIMETRIC FEATURE PLOTTING/SCRIBING		M/HOUR		
1407	TOPOGRAPHY PLOTTING/SCRIBING		M/HOUR		
1408	CADD OPERATOR (EDITOR)		M/HOUR		
1409	MAP EDITING (OFFICE)		M/HOUR		
	REPRODUCTION:				
1410	BLUE-LINE PRINTS *[F-SIZE]		EACH		
1411	FILM TRANSPARENCIES *[F-SIZE]		EACH		
1412	CADD-GENERATED PRINTS (PAPER/B&W))		EACH		
1420	PHOTOGRAMMETRIC PROJECT MANAGER		M/HOUR		
1430	CHIEF PHOTOGRAMMETRIST (PRODUCTION MANAGER)		M/HOUR		
1440	COMPUTER USAGE: (CADD COMPUTER CONNECT TIME CHARGES NOT INCLUDED IN OVERHEAD)		*[MIN] [HOUR]		
1450	*[other requirements]				
1600	NONTOPOGRAPHIC PHOTOGRAMMETRY		JOB	L/S	
1601	*[other nontopographic requirements]				

SECTION C

STATEMENT OF WORK

C.1 GENERAL. THE CONTRACTOR, OPERATING AS AN INDEPENDENT CONTRACTOR AND NOT AS AN AGENT OF THE GOVERNMENT, SHALL PROVIDE ALL LABOR, MATERIAL, AND EQUIPMENT NECESSARY TO PERFORM THE PROFESSIONAL PHOTOGRAMMETRIC MAPPING *[AND RELATED SURVEYING WORK] *[FROM TIME TO TIME] DURING THE PERIOD OF SERVICE AS STATED IN SECTION D, IN CONNECTION WITH PERFORMANCE OF PHOTOGRAMMETRIC MAPPING AND RELATED SURVEYS AND THE PREPARATION OF SUCH MAPS AS MAY BE REQUIRED FOR *[ADVANCE PLANNING,] [DESIGN,] [AND CONSTRUCTION] [or other function] ON [VARIOUS PROJECTS] [specify project(s)]. THE CONTRACTOR SHALL FURNISH THE REQUIRED PERSONNEL, EQUIPMENT, SURVEYING AND PHOTOGRAMMETRIC REDUCTION/COMPILATION INSTRUMENTS, AIRCRAFT, AND LAND TRANSPORTATION AS NECESSARY TO ACCOMPLISH THE REQUIRED SERVICES AND FURNISH TO THE GOVERNMENT MAPS, DIGITAL TERRAIN DATA, REPORTS, AND OTHER DATA TOGETHER WITH SUPPORTING MATERIAL DEVELOPED DURING THE FIELD DATA ACQUISITION PROCESS. DURING THE PROSECUTION OF THE WORK, THE CONTRACTOR SHALL PROVIDE ADEQUATE PROFESSIONAL SUPERVISION AND QUALITY CONTROL TO ASSURE THE ACCURACY, QUALITY, COMPLETENESS, AND PROGRESS OF THE WORK.

NOTE: The above clause is intended for use in an IDT contract for photogrammetric mapping services. It may be used for fixed-price photogrammetric mapping service contracts by deleting appropriate IDT language and adding the specific project survey required. This clause is not repeated on individual delivery orders.

C.2. LOCATION OF WORK.

NOTE: Use the following clause for a fixed-scope contract or individual work order.

C.2.1. PHOTOGRAMMETRIC MAPPING AND RELATED SURVEYING SERVICES WILL BE PERFORMED AT [_____] *[list project area, state, installation, etc.].
*[A MAP DETAILING THE WORK SITE IS ATTACHED AT SECTION G OF THIS CONTRACT.]

NOTE: Use the following when specifying an indefinite delivery contract for photogrammetric mapping services.

C.2.2. PHOTOGRAMMETRIC MAPPING AND RELATED SURVEYING SERVICES WILL BE PERFORMED IN CONNECTION WITH PROJECTS *[LOCATED IN] [ASSIGNED TO] THE [_____] DISTRICT. *[THE _____ DISTRICT INCLUDES THE GEOGRAPHICAL REGIONS WITHIN *[AND COASTAL WATERS] [AND RIVER SYSTEMS] ADJACENT TO:]

*[list states, regions, etc.]

NOTE: Add also any local points-of-contact, right-of-
entry requirements, clearing restrictions, installation
security requirements, etc.

C.3 TECHNICAL CRITERIA AND STANDARDS. THE FOLLOWING STANDARDS ARE REFERENCED IN THIS CONTRACT. IN CASES OF CONFLICT BETWEEN THESE TECHNICAL SPECIFICATIONS AND ANY REFERENCED TECHNICAL STANDARD, THESE SPECIFICATIONS SHALL HAVE PRECEDENCE.

C.3.1. USACE EM 1110-1-1000, PHOTOGRAMMETRIC MAPPING. THIS REFERENCE IS ATTACHED TO AND MADE PART OF THIS CONTRACT. (SEE CONTRACT SECTION G.)

C.3.2. USACE EM 1110-1-1002, SURVEY MARKERS AND MONUMENTATION. *[THIS REFERENCE IS ATTACHED TO AND MADE PART OF THIS CONTRACT. (SEE CONTRACT SECTION G.)]

C.3.3. USACE EM 1110-1-1807, STANDARDS MANUAL FOR USACE COMPUTER-AIDED DESIGN AND DRAFTING (CADD) SYSTEMS.

C.3.4. MANUAL OF PHOTOGRAMMETRY, ASPRS, *[_____] EDITION.

C.3.5. *United States National Map Accuracy Standards, US Bureau of the Budget, 17 June 1947.

C.3.6. *Reference Guide Outline: Specifications for Aerial Surveys and Mapping by Photogrammetric Methods for Highways, US Department of Transportation, Federal Highway Administration, Washington, DC, 1968.

C.3.7. ASPRS Accuracy Standards for Large-Scale Maps, ASPRS, March 1990.

C.3.8. *Standards and Specifications for Geodetic Control Networks, Federal Geodetic Control Committee (FGCC), September 1984.

C.3.9. *[District Drafting Standards Manual]

C.3.10. *Flood Insurance Study-Guidelines and Specifications for Study Contractors, Federal Emergency Management Agency (FEMA), Federal Insurance Administration, Publication FEMA 37, March 1991.

NOTE: List other reference standards that may be applica-
ble to some phase of the work. Reference may also be made
to other EM's or standard criteria documents. Such docu-
ments need not be attached to the Contract; if attached,
however, reference should be made to their placement in
contract Section G.

C.4 WORK TO BE PERFORMED. PROFESSIONAL PHOTOGRAMMETRIC MAPPING AND RELATED SURVEYING SERVICES TO BE PERFORMED UNDER THIS CONTRACT ARE DEFINED BELOW. UNLESS OTHERWISE INDICATED IN THIS CONTRACT *[OR IN DELIVERY ORDERS THERETO],

EACH REQUIRED SERVICE SHALL INCLUDE FIELD-TO-FINISH EFFORT. ALL MAPPING WORK WILL BE PERFORMED USING PRECISE PHOTOGRAMMETRIC DATA ACQUISITION, MENSURATION, AND COMPILATION PROCEDURES, INCLUDING ALL QUALITY CONTROL ASSOCIATED WITH THESE FUNCTIONS. THE WORK WILL BE ACCOMPLISHED IN STRICT ACCORDANCE WITH THE PHOTOGRAMMETRIC MAPPING CRITERIA CONTAINED IN THE TECHNICAL REFERENCES (PARAGRAPH C.3 ABOVE), EXCEPT AS MODIFIED OR AMPLIFIED HEREIN.

NOTE: The following clauses in this section of the guide may be used for either fixed-price photogrammetric mapping contracts, IDT work orders under a photogrammetric mapping IDT contract, or IDT contracts where photogrammetric mapping services are part of a schedule of various survey disciplines.

C.4.1. PURPOSE OF WORK. THE WORK TO BE PERFORMED UNDER THIS CONTRACT IS TO BE USED AS BASIC SITE PLAN MAPPING INFORMATION FOR *[INSTALLATION MASTER PLANNING] [DESIGN] [CONSTRUCTION] [OPERATION] [MAINTENANCE] [REAL ESTATE] [REGULATORY ENFORCEMENT] [HAZARDOUS AND TOXIC WASTE SITE _____] [_____]; INCLUDING THOSE RELATED ACTIVITIES AND/OR ENGINEERING STUDIES COVERING SUCH PERTINENT DETAILS AS *[RESERVOIR CAPACITIES] [CHANNEL CAPACITIES] [DAMAGE ASSESSMENT] [BENEFITS] [PROJECT LOCATION] [DESIGN OF MAIN STRUCTURE AND APPURTENANCES] [RELOCATIONS] [LAND ACQUISITION] [LAND DEVELOPMENT AND MANAGEMENT] [ENCROACHMENT] [CONSTRUCTION MEASUREMENT AND PAYMENT] [_____].

NOTE: A brief description of the functional purpose of the photography/mapping (in the above clause) is absolutely essential in that the contractor can focus his efforts and quality control toward the more critical aspects of the project. The above clause should be written so that it explicitly describes the overall functional purpose of the mapping effort plus any critical design (and construction) work that will be performed using the product. This information can be used by the contractor to optimize flight alignment, ground control, stereocompilation, etc., in order to ensure coverage of critical areas.

C.4.2. GENERAL MAPPING REQUIREMENTS. PHOTOGRAMMETRICALLY COMPILED LINE MAPS AT A TARGET SCALE OF 1 IN. = [_____] FT ARE REQUIRED FOR THE [_____] -ACRE SITE DELINEATED ON THE MAP ATTACHED AT SECTION G. THE MAPPING AND/OR RELATED DIGITAL PRODUCTS SHALL MEET USACE (ASPRS) CLASS *[_____] ACCURACY STANDARDS AS SPECIFIED IN EM 1110-1-1000. PLANIMETRIC FEATURE DETAIL WILL BE COMPILED BASED ON THIS HORIZONTAL MAPPING STANDARD. CONTOURS SHALL BE DEVELOPED AT [_____] -FT INCREMENTS IN ACCORDANCE WITH THE VERTICAL ACCURACY STANDARDS. THE SITE SHALL BE FLOWN AT A PHOTO-NEGATIVE SCALE EQUAL TO OR LARGER THAN THAT SPECIFIED IN EM 1110-1-1000 TO MEET THE REQUIRED PLANIMETRIC AND TOPOGRAPHIC ACCURACY CRITERIA. FEATURE AND TERRAIN DATA SHALL BE DELIVERED IN DIGITAL FORMAT.

NOTE: The above clause should be used for fixed-scope contracts or IDT contract work orders to give a brief overview of the general mapping effort, the technical requirements of which will be described in subsequent paragraphs of the contract.

Note that the final map compilation target scale and ASPRS accuracy class/standard are specifically and rigidly defined upfront in the scope. These parameters directly define the required, or maximum allowable, flight altitude (and negative scales) by reference to the criteria in EM 1110-1-1000.

IDT contracts and work orders: Since specific project scopes are indefinite at the time a basic contract is prepared, only general technical criteria and standards can be outlined. Project or site-specific criteria, in clauses similar to the above, will be contained in each delivery order, along with any deviations from technical standards identified in the basic IDT contract. The clauses contained throughout the rest of the contract are used to develop the general requirements for a basic IDT contract. Subsequent delivery orders will reference these clauses, adding project-specific work requirements as required. Delivery order formats should follow the outline established for the basic IDT contract.

C.4.3. COMPLETION OF WORK. ALL WORK MUST BE COMPLETED AND DELIVERED NOT LATER THAN [_____]. *[Add pre/partial submittal schedules, if applicable.]

C.5. AIRCRAFT FLIGHT OPERATIONS AND EQUIPMENT REQUIREMENTS.

C.5.1. AIRCRAFT AND FLIGHT CREW. THE AIRCRAFT FURNISHED OR UTILIZED UNDER THIS CONTRACT SHALL BE EQUIPPED WITH NAVIGATION AND PHOTOGRAPHIC INSTRUMENTS AND ACCESSORIES NECESSARY TO SATISFACTORILY PRODUCE THE REQUIRED PHOTOGRAPHY. THE AIRCRAFT SHALL BE MAINTAINED IN OPERATIONAL CONDITION DURING THE PERIOD OF THIS CONTRACT, AND SHALL CONFORM WITH ALL GOVERNING FEDERAL AVIATION ADMINISTRATION AND CIVIL AERONAUTICS BOARD REGULATIONS OVER SUCH AIRCRAFT. THE FLIGHT CREW AND CAMERAMAN SHALL HAVE HAD A MINIMUM OF 400 HOURS EXPERIENCE IN FLYING PRECISE PHOTOGRAMMETRIC MAPPING MISSIONS.

C.5.2. CAMERA WINDOWS AND CAMERA MOUNTING. WHEN HIGH-ALTITUDE PHOTOGRAPHY IS REQUIRED, CAMERA WINDOWS MAY BE NEEDED. CAMERA WINDOWS SHALL BE MOUNTED IN VIBRATION-DAMPING MATERIAL TO AVOID MECHANICAL STRESS TO THE WINDOW. PRIOR TO PHOTOGRAPHY, ANY CAMERA WINDOW USED SHALL BE CHECKED BY THE CALIBRATION CENTER TO ENSURE THAT IT WILL NOT ADVERSELY AFFECT LENS RESOLUTION AND DISTORTION AND THAT IT IS SUBSTANTIALLY FREE OF VEINS, STRIATIONS, AND OTHER INHOMOGENEITIES. THE CAMERA ITSELF SHALL BE INSTALLED IN A MOUNTING THAT DAMPENS THE EFFECTS OF AIRCRAFT VIBRATION. AIRCRAFT EXHAUST GASES SHALL BE VENTED AWAY FROM CAMERA OPENING.

NOTE: The two clauses above represent minimum standards possessed by most professional aerial mapping contractors, and are inherent in the quality control function. Government inspection of these standards is neither practical nor expected.

C.5.3. FLIGHT PLAN. THE MINIMUM AREA(S) TO BE PHOTOGRAPHED ARE AS INDICATED ON MAPS *[ATTACHED AT SECTION G] [WHICH WILL BE PROVIDED FOR EACH PHOTOGRAPHIC DELIVERY ORDER]. GIVEN THE SPECIFIED PHOTO-NEGATIVE SCALE CRITERIA HEREIN, THE CONTRACTOR SHALL DESIGN THE FLIGHT LINES FOR THE PHOTOGRAPHY TO OBTAIN PROPER OVERLAP, SIDELAP, AND ENDLAP TO ASSURE FULL STEREOSCOPIC PHOTOGRAPHIC COVERAGE, IN ACCORDANCE WITH THE CRITERIA DEFINED IN THIS CONTRACT *[OR DELIVERY ORDER THERETO]. GENERALLY, THE FLIGHT LINES SHALL BE PARALLEL TO EACH OTHER AND TO THE LONGEST BOUNDARY LINES OF THE AREA TO BE PHOTOGRAPHED. FOR SINGLE STRIP PHOTOGRAPHY, THE ACTUAL FLIGHT LINE SHALL NOT VARY FROM THE LINE PLOTTED ON THE FLIGHT MAP BY MORE THAN THE SCALE OF THE PHOTOGRAPHY EXPRESSED IN FEET. FOR EXAMPLE, THE ALLOWABLE TOLERANCE FOR PHOTOGRAPHY FLOWN AT A SCALE OF 1 IN. EQUALS 1000 FT IS ABOUT 1000 FT. THE FLIGHT LINES SHALL *[NOT] BE SUBMITTED TO THE GOVERNMENT FOR ADVANCE APPROVAL.

NOTE: Flight planning alignment and other details are best left to the professional contractor to design, given his experience in optimizing aircraft utilization during transit and flight operations and stereoscopic coverage. In most cases, the guide writer need only reference small-scale maps or drawings depicting the area to be mapped, or provide geographical/grid coordinates defining the area/route. During the initial planning discussions with the functional user, the outline of project limits for both aerial photography and mapping should be clearly defined, preferably on the best available map. US Geological Survey (USGS) quadrangle maps at scales of 1:24,000 or 1:62,500 are particularly good for this purpose.

Detailed flight maps will then be prepared by the photogrammetric contractor for his flight crew. The map on which the flight lines are drawn should be the best available map of the project area. Previously flown aerial photographs can also be used, especially when reflights of this photography are ordered. Should functional project requirements dictate a particular flight alignment, then the guide writer should incorporate that into the specifications (e.g., regulatory enforcement photography being flown parallel to a shoreline). For areas having irregular boundaries or for meandering streams, block flying, that is, two or more parallel flight lines to cover the area, is preferable to many short lines designed to follow each irregularity of the project area. Also, consideration should be given to roads and trails

adjacent to the project area. Incorporating these access routes into the photography frequently will facilitate the necessary ground surveys for photo control. Flight line design must recognize potential flight hazards, and lines should be parallel to the ridge lines of mountains rather than leading into them.

USACE Commands may require that proposed flight plans be submitted to the Contracting Officer for approval. Unless there is some unusual technical or military operational purpose for this requirement, such preapprovals should not be required.

C.5.4. FLYING CONDITIONS. PHOTOGRAPHY SHALL BE UNDERTAKEN ONLY WHEN WELL-DEFINED IMAGES CAN BE OBTAINED. UNLESS OTHERWISE SPECIFIED, FLYING SHALL BE LIMITED TO THE PERIOD OF 3 HOURS AFTER LOCAL SUNRISE TO 3 HOURS BEFORE LOCAL SUNSET. *[PHOTOGRAPHY SHALL BE ACCOMPLISHED BETWEEN THE HOURS OF *[_] AND *[_], LOCAL SOLAR TIME.] *[PHOTOGRAPHY SHALL NOT CONTAIN SHADOWS CAUSED BY TOPOGRAPHIC RELIEF OR SUN ANGLE OF LESS THAN *[THIRTY (30)] [_] DEGREES, WHENEVER SUCH SHADOWS CAN BE AVOIDED DURING THE TIME OF YEAR THE PHOTOGRAPHY MUST BE TAKEN.] PHOTOGRAPHY SHALL NOT BE ATTEMPTED WHEN THE GROUND IS OBSCURED BY HAZE, SMOKE, OR DUST, *[SNOW] OR WHEN THE CLOUDS OR CLOUD SHADOWS WILL APPEAR ON MORE THAN *[FIVE (5)] [_] PERCENT OF THE AREA OF ANY ONE PHOTOGRAPH.

NOTE: The above clause should be modified based on the project requirements. For detailed large-scale line mapping, obviously no obscured areas can be tolerated, whereas for simple small-scale photo coverage and/or enlargements, some reasonable obscuring is allowable. Light snow cover may be an asset in some instances. Overrestriction of clear coverage requirements, time, or dates can significantly increase the cost of a project.

C.5.5. *DATE OF PHOTOGRAPHY. PHOTOGRAPHY MUST BE FLOWN DURING THE PERIOD [_] IN ORDER TO ADEQUATELY DELINEATE [_]. *[PHOTOGRAPHY WILL BE FLOWN DURING THE PERIODS REPRESENTED IN WORK ORDERS PLACED AGAINST THIS BASIC CONTRACT.]

NOTE: Include any dates within which photography must be taken, such as during minimum foliage, operational movement, construction excavation/placement period, certain river/reservoir stage, high/low tide, etc. Such a clause might be required when photogrammetric methods are used for measuring construction excavation or placement, and photo missions are performed at defined periods. The above clause is applicable to either fixed-scope contracts or IDT contract work orders.

C.5.6. AIRCRAFT UTILIZATION. TOTAL AIRCRAFT UTILIZATION TO, FROM, BETWEEN, AND OVER PROJECT SITES IS BASED ON THE PROVISIONS CONTAINED IN SECTION B. IN ESTIMATING AVAILABLE AIRCRAFT OPERATIONAL TIME, AVERAGE WEATHER AND CLOUD COVER CONDITIONS ARE ASSUMED FOR THE GIVEN SITE AND TIME OF YEAR, CONSISTENT WITH AIRCRAFT UTILIZATION RATES HISTORICALLY DEVELOPED. ADDITIONAL CREW COSTS WILL ACCRUE DURING DEPLOYMENT AT OR NEAR THE PROJECT SITE, WHERE APPLICABLE. AIRCRAFT AND FLIGHT CREW STANDBY AT THE HOME BASE SHALL BE CONSIDERED AS AN OVERHEAD EXPENSE AND SHALL HAVE BEEN PROPERLY FACTORED INTO THE UNIT RATE OF THE AIRCRAFT.

NOTE: Aircraft hourly rates are based on long-term utilizations while performing typical project/flight missions. These rates include overhead associated with normal weather delays. These utilizations should be confirmed by field audit. If the project (or delivery order) is not typical in scope or location, then adjustment to the established rates may be warranted. Otherwise, provide detailed requirements, conditions, notification procedures, and compensation provisions for emergency dedication of an aircraft. Direct and indirect costs must be clearly identified in establishing the crew-day rate for such an item.

C.5.7. *EMERGENCY AIRCRAFT STANDBY.

C.5.8. *OCONUS FLIGHT OPERATIONS. [Add other nonstandard photogrammetric aircraft and flight crew costs. Detail as required or if not fully defined in Section B.]

C.5.9. FLIGHT LOG. FOR EACH FLIGHT DAY, THE PILOT OR CAMERAMAN SHALL PREPARE A FLIGHT LOG CONTAINING THE DATE, PROJECT NAME, AIRCRAFT USED, AND NAMES OF CREW MEMBERS. IN ADDITION, THE FOLLOWING SHALL BE PREPARED FOR EACH FLIGHT LINE: ALTITUDE, CAMERA, MAGAZINE SERIAL NUMBER, F-STOP, SHUTTER SPEED, BEGINNING AND ENDING EXPOSURE NUMBERS AND TIMES, AND ANY OTHER COMMENTS RELATIVE TO THE FLIGHT CONDITIONS. THESE FLIGHT LOGS, OR COPIES THEREOF, MAY BE INCORPORATED INTO THE FILM REPORT (IF REQUIRED) AND WILL BE DELIVERED TO THE CONTRACTING OFFICER AS SPECIFIED IN THIS CONTRACT.

C.5.10. SUBCONTRACTED PHOTOGRAPHY. BEFORE COMMENCEMENT OF ANY AERIAL PHOTOGRAPHY UNDER THIS CONTRACT *[OR WORK ORDER] BY A SUBCONTRACTOR, THE CONTRACTOR SHALL FURNISH THE CONTRACTING OFFICER, IN WRITING, THE NAME OF SUCH SUBCONTRACTOR, TOGETHER WITH A STATEMENT AS TO THE EXTENT AND CHARACTER OF THE WORK TO BE DONE UNDER THE SUBCONTRACT, INCLUDING APPLICABLE CAMERA CERTIFICATIONS.

NOTE: Reasonable flexibility should be provided contractors in substituting aircrafts or cameras to meet the exigencies of the operations. Ideally, potential subcontractors will have been identified during initial submittal/negotiations. In practice, unforeseen

aircraft/camera substitution is often required in order to meet critical delivery dates.

C.6. AERIAL PHOTOGRAPHY SCALE AND RELATED COVERAGE PARAMETERS.

C.6.1. PHOTO-NEGATIVE SCALE AND FLIGHT ALTITUDE. THE REQUIRED NEGATIVE SCALE FOR THIS PROJECT *[SHALL EQUAL OR EXCEED THE CRITERIA CONTAINED IN EM 1110-1-1000] [IS 1 IN. = *[] FT] [WILL BE DEFINED IN THE SCOPE OF WORK PROVIDED WITH EACH DELIVERY ORDER], AND SHALL BE CONSISTENT WITH THE REQUIRED MAP ACCURACY STANDARD/CLASS SPECIFIED AND THE MAXIMUM ALLOWABLE ALTITUDES SPECIFIED IN EM 1110-1-1000 FOR MAINTAINING HORIZONTAL AND VERTICAL TOLERANCES RELATIVE TO FLIGHT ALTITUDE. THE FLIGHT HEIGHT ABOVE THE AVERAGE ELEVATION OF THE GROUND IS DESIGNED SUCH THAT THE NEGATIVES HAVE AN AVERAGE SCALE SUITABLE FOR ATTAINING REQUIRED PHOTOGRAMMETRIC MEASUREMENT, MAP SCALE, CONTOUR INTERVAL, AND ACCURACY, GIVEN THE REQUIRED (FIXED) 6-IN. MAPPING CAMERA FOCAL LENGTH, STEREOPLOTTER MODEL, AND QUALITY CONTROL CRITERIA, AS DEFINED ELSEWHERE IN THESE SPECIFICATIONS. *[NEGATIVES HAVING A DEPARTURE FROM THE SPECIFIED SCALE OF MORE THAN 5 PERCENT BECAUSE OF TILT OR ANY CHANGES IN THE FLYING HEIGHT MAY BE CAUSE FOR REJECTION OF THE WORK.] *[DEPARTURES FROM SPECIFIED FLIGHT HEIGHT SHALL NOT EXCEED 2 PERCENT LOW OR 5 PERCENT HIGH FOR ALL FLIGHT HEIGHTS UP TO 12,000 FT ABOVE GROUND ELEVATION. ABOVE 12,000 FT, DEPARTURES FROM SPECIFIED FLIGHT HEIGHT SHOULD NOT EXCEED 2 PERCENT LOW OR 600 FT HIGH.] ANY PROPOSED VARIATION BY THE CONTRACTOR TO CHANGE EITHER THE CAMERA FOCAL LENGTH OR NEGATIVE SCALE CONSTITUTES A MAJOR CHANGE IN SCOPE AND THEREFORE MUST BE EFFECTED BY FORMAL CONTRACT *[DELIVERY ORDER] MODIFICATION.

NOTE: No aspect of the photogrammetric mapping specification process is more critical—and subject to abuse—than that limiting flight altitudes or negative scales. This is due to their direct impact on photo/model coverage, resultant planimetric/topographic accuracy, ground control requirements, and overall project cost. Since costs vary exponentially with negative scale, even minor variations can be significant.

EM 1110-1-1000 provides maximum flight altitudes for the various map accuracy requirements. The specification writer may simply require conformance with the criteria in this manual, or must specify a firm, fixed negative scale that optimizes both accuracy and cost. Use of the manual's criteria is recommended. Any modifications to this negative scale proposed by the photogrammetric contractor during such negotiations (or after award) must be substantiated by appropriate revisions to the Government estimate, or modification, as required. No contract should ever be awarded with indefinite "open-ended" negative scales subject to the contractor's "expert recommendation" or "discretion."

C.6.2. STEREOSCOPIC COVERAGE AND OVERLAP REQUIREMENTS. *[UNLESS OTHERWISE MODIFIED IN DELIVERY ORDERS] THE OVERLAP SHALL BE SUFFICIENT TO PROVIDE FULL STEREOSCOPIC COVERAGE OF THE AREA TO BE PHOTOGRAPHED, AS FOLLOWS:

NOTE: Many of the following overlap and photo orientation specifications are throwbacks to older 1950's vintage mechanical-optical train stereoplotter requirements or restrictions. Newer analytical stereoplotters are not so sensitive to excesses in these parameters. However, these specifications may optionally be retained as a form of contractor quality control, plus assuring that, at the least, photography is obtained that can be viewed stereoscopically by nonanalytical devices.

USACE Commands rarely have the resources, time, or equipment to check compliance with these orientation requirements; therefore, clauses are given optional enforcement/rejection provisions. In most cases, poorly flown photography will be rejected by the contractor's internal quality control procedures and will be reflight before compilation proceeds.

a. BOUNDARIES. ALL OF THE AREA APPEARING ON THE FIRST AND LAST NEGATIVE IN EACH FLIGHT LINE EXTENDING OVER A BOUNDARY SHALL BE OUTSIDE THE BOUNDARY OF THE PROJECT AREA. THE PRINCIPAL POINT OF TWO PHOTOGRAPHS ON BOTH ENDS OF EACH FLIGHT LINE SHALL BE TAKEN PAST THE BOUNDARY LINE OF THE PROJECT. EACH STRIP OF PHOTOGRAPHS ALONG A BOUNDARY SHALL EXTEND OVER THE BOUNDARY NOT LESS THAN *[FIFTEEN (15)] [_____] (____)] PERCENT OF THE WIDTH OF THE STRIP.

b. ENDLAP. *[Unless otherwise specified in a delivery order,] the forward overlap shall be *sixty (60) percent *[± five (5)] [± _____ (____)] percent. Endlap of less than *[fifty-five (55)] [_____] (____)] percent in one or more negatives may be cause for rejection of the negative or negatives in which such deficiency or excess of endlap occurs.

NOTE: A maximum endlap specification is optional—it need not be restricted and is often deliberately increased to 80 percent ± 3 percent for analytical aerotriangulation or vertical viewing requirements. This will impact compilation cost, however.

c. SIDELAP. *[Unless otherwise specified in a delivery order,] the lateral sidelap shall average *[thirty (30)] [_____] (____)] percent *[± ten (10)] [± _____ (____)] percent. Any negative having sidelap less than *[fifteen (15)] [_____] (____)] percent or more than *[fifty (50)] [_____] (____)] percent may be rejected. The foregoing requirement can be varied in cases where the strip area to be mapped is slightly wider than the area that can be covered by one strip of photographs, where increase in

sidelap is required for control densification purposes, or where increase or decrease in sidelap is required to reach established ground control.

d. CRAB. Absolute crab of any photograph relative to the flight line, or relative crab between any series of two or more consecutive photographs, in excess of *[10] [____] degrees, as indicated by displacement of the principal points of the photographs, may be considered cause for rejection of the photography. Average crab for any flight line shall not exceed *[5] [____] degrees. For aerotriangulation, no photograph shall be crabbed in excess of five (5) degrees as measured from the line of flight.

e. TILT. Negatives exposed with the optical axis of the aerial camera in a vertical position are desired. Tilt (angular departure of the aerial camera axis from a vertical line at the instant of exposure) in any negative of more than *[four (4)] [____] [____] degrees, or an average of more than *[two (2)] [____] [____] degrees for any ten (10) consecutive frames, or an average tilt of more than *[one (1)] [____] [____] degree(s) for the entire project, or relative tilt between any two successive negatives exceeding *[six (6)] [____] [____] degrees may be cause for rejection.

f. TERRAIN ELEVATION VARIANCES. When ground heights within the area of overlap vary by more than ten (10) percent of the flying height, a reasonable variation in the stated overlaps shall be permitted provided that the fore and aft overlaps do not fall below *[55] [____] percent and the lateral sidelap does not fall below *[10] [____] percent or exceed *[50] [____] percent. In extreme terrain relief where the foregoing overlap conditions are impossible to maintain in straight and parallel flight lines, the gaps created by excessive relief may be filled by short strips flown between the main flight lines and parallel to them.

g. Strips running parallel to a shoreline may be repositioned to reduce the proportion of water covered, provided the coverage extends beyond the limit of any land feature by at least 10 percent of the strip width.

C.6.3. Where the ends of strips of photography join the ends of other strips or blocks flowing in the same general direction, there shall be an overlap of at least two stereoscopic models. In flight lines rephotographed to obtain substitute photography for rejected photography, all negatives shall be exposed to comply with original flight specifications, including scale and overlap requirements. The joining end negatives in the replacement strip shall have complete stereoscopic coverage of the contiguous area on the portion or portions not rejected.

C.6.4. *OBLIQUE PHOTOGRAPHY.

NOTE: Detail herein any oblique photography and/or oblique photogrammetric mapping compilation requirements. Camera tilts in excess of 5 degrees are classified as oblique photographs. These photographs are used primarily for pictorial views of large areas. They may also be used in supplementary mapping of complicated plant sites where pipelines may be obscured in vertical photographs of the plant, and as

such would be compiled on an analytical plotter. Oblique photographs are often taken using high-quality hand-held cameras, or using specially designed aerial mapping camera mounts. A high oblique aerial photograph is one in which the horizon (where the earth and sky appear to meet) is visible. Units of measure for oblique photography are typically on a lump sum (job) basis, and when no controlled compilation is involved, may be obtained by Invitation for Bids (IFB)/purchase order procedures. An example would be a high oblique of an installation for a visitor information center.

C.7. AERIAL CAMERA SPECIFICATIONS.

C.7.1. TYPE OF CAMERA. ONLY A STANDARD 6-IN. (153mm \pm 3mm) FOCAL-LENGTH SINGLE-LENS PRECISE AERIAL MAPPING CAMERA, EQUIPPED WITH A HIGH-RESOLUTION, DISTORTION-FREE LENS, AND WITH A BETWEEN-THE-LENS SHUTTER WITH VARIABLE SPEED, SHALL BE USED ON THIS CONTRACT. THE AERIAL CAMERA USED SHALL BE OF LIKE/ SIMILAR QUALITY TO A *[Wild U. Aviogon] *[Zeiss Pleogon A] *[Jena Lamagon Pl] *[Wild Model RC10] *[Wild RC-8], OR *[Zeiss Model RMK-A 15/23]. THE CAMERA SHALL FUNCTION PROPERLY AT THE NECESSARY ALTITUDE AND UNDER EXPECTED CLIMATIC CONDITIONS, AND SHALL EXPOSE A 9- by 9-IN.- (228 by 228mm-) SQUARE NEGATIVE. THE LENS CONE SHALL BE SO CONSTRUCTED THAT THE LENS, FOCAL PLANE AT CALIBRATED FOCAL LENGTH, FIDUCIAL MARKERS, AND MARGINAL DATA MARKERS, COMPRISE AN INTEGRAL UNIT OR ARE OTHERWISE FIXED IN RIGID ORIENTATION WITH ONE ANOTHER. *WHEN EXTREMELY LARGE SCALE (LOW ALTITUDE) PHOTOGRAPHY IS BEING FLOWN, THE CAMERA SHALL BE EQUIPPED WITH FORWARD IMAGE MOTION COMPENSATION.

C.7.2. CALIBRATION. THE AERIAL CAMERA(S) FURNISHED BY THE CONTRACTOR OR HIS DESIGNATED SUBCONTRACTORS SHALL HAVE BEEN CALIBRATED BY THE USGS WITHIN *[THREE (3)] [_____] (___) YEARS OF AWARD OF THIS CONTRACT. THE CALIBRATION REPORT SHALL BE PRESENTED TO THE CONTRACTING OFFICER PRIOR TO USE ON THIS CONTRACT *[AND/OR DELIVERY ORDERS PLACED AGAINST THIS CONTRACT]. CALIBRATED TOLERANCES SHALL BE WITHIN THE STANDARDS CONTAINED IN EM 1110-1-1000. *[Certification shall also be provided indicating that preventative maintenance has been performed within the last two (2) years.]

C.7.3. SUBSTITUTE CAMERAS. SUBSTITUTE CAMERAS THAT DO NOT MEET THE ABOVE SPECIFICATIONS MAY NOT BE USED ON THIS CONTRACT *[OR DELIVERY ORDERS THERETO].

NOTE: It is critical to maintain consistency in aerial cameras used for detailed design line mapping work. Therefore, only 6-in. focal length cameras are recommended in this guide. Use of different cameras with nonstandard focal lengths may affect not only the quality of work but also the unit prices configured in Schedule B. The contract should not allow unlimited flexibility to substitute cameras based on a mapping contractor's recommendation. If a special type of camera is used for a particular project, then

specifications for that camera and associated costs must be detailed herein or by modification.

Numerous camera calibration specification and tolerance requirements are embodied in the contract by reference to EM 1110-1-1000. These include tolerances for focal length, magazine platen, fiducial marks, lens distortion, lens resolving power, filters, shutters, apertures, and spectral ranges. There is no need to repeat these technical specifications in this contract. Restrictions to like/similar camera models, along with the requirement for USGS calibration certification, help assure that quality photography will be obtained.

C.8. AERIAL FILM SPECIFICATIONS AND PROCESSING REQUIREMENTS.

C.8.1. GENERAL. FILM MATERIALS AND LABORATORY PROCESSING, DEVELOPING, REPRODUCTION, AND PRINTING THEREOF, SHALL CONFORM WITH RECOGNIZED PROFESSIONAL PHOTOGRAMMETRIC INDUSTRY STANDARDS AND PRACTICES, AS OUTLINED IN EM 1110-1-1000 AND IN CHAPTER 6 OF THE ASPRS MANUAL OF PHOTOGRAMMETRY, AND OTHER NATIONAL STANDARDS OR SPECIFICATIONS REFERENCED THEREIN.

NOTE: For professional service "field-finish" line mapping contracts, it is necessary to include only general guidance over the quality of materials and professional photographic laboratory practices. Since the professional mapping firm is responsible for the ultimate accuracy and quality of the compiled line maps, that firm will usually strive to utilize the highest-quality materials and related processes to achieve that goal. Deficiencies in materials, coverage gaps, obscured features, etc., will be readily apparent during stereocompilation—in effect, the stereocompilation phase represents a quality control check over the initial data, both photography and ground control. However, when IFB contracts are used to obtain aerial photography (no subsequent controlled compilation), there may be far less internal quality control. In IFB contracts, film material and processing specifications, and Government quality control/quality assurance (QC/QA) efforts, may need to be more detailed.

C.8.2. TYPE OF FILM REQUIRED. THE CONTRACTOR SHALL USE ONLY AERIAL FILM OF A QUALITY THAT IS EQUAL OR SUPERIOR TO 4 MIL KODAK DOUBLE-X AEROGRAPHIC 2405 (ESTAR BASE) PANCHROMATIC FILM; KODAK PLUS-X AEROGRAPHIC 2402 (ESTER BASE); 4 MIL KODAK AEROCOLOR NEGATIVE FILM 2445 (ESTAR BASE); OR 4 MIL KODAK AEROCHROME INFRARED FILM 2443 (ESTAR BASE), AS APPLICABLE TO THOSE TYPES OF PHOTOGRAPHY SCHEDULED IN SECTION B. ONLY FRESH, FINE-GRAIN, HIGH-SPEED, DIMENSIONALLY STABLE, AND SAFETY BASE AERIAL FILM EMULSIONS SHALL BE USED. OUTDATED FILM SHALL NOT BE USED. *[THE THICKNESS OF THE BASE SHALL NOT BE

LESS THAN 0.1 MM AND THE DIMENSIONAL STABILITY SHALL BE SUCH THAT IN ANY NEGATIVE THE LENGTH AND WIDTH BETWEEN FIDUCIALS SHALL NOT VARY BY MORE THAN 0.3 PERCENT FROM THE SAME MEASUREMENTS TAKEN ON THE CAMERA, AND THAT THE DIFFERENTIAL BETWEEN THESE MEASUREMENTS SHALL NOT EXCEED 0.04 PERCENT.]

NOTE: Black and white panchromatic film is the most widely used type for aerial photography. There is a greater latitude in exposure and processing of black and white panchromatic films than there is with color films. Color aerial photography may enhance functional interpretation during the plotting process. Color photography requires above-average weather conditions, meticulous care in exposure and processing, and color-corrected lenses. For these reasons, color photography and color prints are more expensive than panchromatic. Use of color film for detailed line mapping will depend on the difficulty of photo interpretation (by the stereoplotter operator) needed in the project site. Infrared emulsions have greater sensitivity to red and the near infrared, which penetrate haze and smoke. Thus, infrared film can be used on days that would be unsuitable for ordinary panchromatic films. It is also useful for the delineation of water and wet areas, and for certain types of forestry and land use studies. It may be used in the detection of diseased plants and trees, identification and differentiation of a variety of freshwater and saltwater growths for wetland studies, and many water pollution and environmental impact studies. A color-corrected camera lens is required. The cost of obtaining infrared color is greater than black and white. Infrared film would not be specified for detailed line mapping work.

C.8.3. UNEXPOSED FILM. WHENEVER ANY PART OF AN UNEXPOSED ROLL OF FILM REMAINS IN THE CAMERA, BEFORE SUCH FILM IS USED ON A SUBSEQUENT DAY, A MINIMUM 3-FT SECTION OF THE ROLL OF FILM SHALL BE ROLLED FORWARD, AND EXPOSED, IMMEDIATELY PRECEDING THE BEGINNING OF PHOTOGRAPHY.

C.8.4. QUALITY OF PHOTOGRAPHY. THE PHOTOGRAPHIC NEGATIVES SHALL BE TAKEN SO AS TO PREVENT APPRECIABLE IMAGE MOVEMENT AT THE INSTANT OF EXPOSURE. THE NEGATIVES SHALL BE FREE FROM STATIC MARKS, SHALL HAVE UNIFORM COLOR TONE, AND SHALL HAVE THE PROPER DEGREE OF CONTRAST FOR ALL DETAILS TO SHOW CLEARLY IN THE DARK-TONE AREAS AND HIGH-LIGHT AREAS AS WELL AS IN THE HALFTONES BETWEEN DARK AND LIGHT. NEGATIVES HAVING EXCESSIVE CONTRAST OR NEGATIVES LOW IN CONTRAST MAY BE REJECTED.

C.8.5. PROCESSING OF EXPOSED FILM. THE PROCESSING, INCLUDING DEVELOPMENT AND FIXATION AND WASHING AND DRYING OF ALL EXPOSED PHOTOGRAPHIC FILM, SHALL RESULT IN NEGATIVES FREE FROM CHEMICAL OR OTHER STAINS, CONTAINING NORMAL AND UNIFORM DENSITY, AND FINE-GRAIN QUALITY. BEFORE, DURING, AND AFTER PROCESSING, THE FILM SHALL NOT BE ROLLED TIGHTLY ON DRUMS OR IN ANY, WAY STRETCHED, DISTORTED, SCRATCHED, OR MARKED, AND SHALL BE FREE FROM FINGER

MARKS, DIRT, OR BLEMISHES OF ANY KIND. EQUIPMENT USED FOR PROCESSING SHALL BE EITHER REWIND SPOOL-TANK OR CONTINUOUS PROCESSING MACHINE, AND MUST BE CAPABLE OF ACHIEVING CONSISTENT NEGATIVE QUALITY SPECIFIED BELOW WITHOUT CAUSING DISTORTION OF THE FILM. DRYING OF THE FILM SHALL BE CARRIED OUT WITHOUT AFFECTING ITS DIMENSIONAL STABILITY.

C.8.6. THE CAMERA PANEL OF INSTRUMENTS SHOULD BE CLEARLY LEGIBLE ON ALL PROCESSED NEGATIVES. FAILURE OF INSTRUMENT ILLUMINATION DURING A SORTIE SHALL BE CAUSE FOR REJECTION OF THE PHOTOGRAPHY. ALL FIDUCIAL MARKS SHALL BE CLEARLY VISIBLE ON EVERY NEGATIVE.

C.8.7. FILM STRIP DOCUMENTATION AND LABELING. AT MINIMUM, THE FOLLOWING INFORMATION SHALL BE SUPPLIED AS LEADERS AT THE START AND THE END OF EACH FILM STRIP:

- a. CONTRACT NUMBER AND/OR DELIVERY ORDER DESIGNATION, AS APPLICABLE.
- b. FILM NUMBER.
- c. FLIGHT LINE IDENTIFICATION(S).
- d. DATES/TIMES OF PHOTOGRAPHY.
- e. EFFECTIVE NEGATIVE NUMBERS AND RUN NUMBERS.
- f. APPROXIMATE SCALE(S) OF PHOTOGRAPHY.
- g. THE CALIBRATED FOCAL LENGTH OF THE CAMERA.
- h. CONTRACTOR'S NAME.

C.8.8. NEGATIVE NUMBERING AND ANNOTATION. EACH NEGATIVE WILL BE LABELED CLEARLY WITH THE IDENTIFICATION SYMBOL AND NUMBERING CONVENTION RECOMMENDED HEREIN. THE NUMBERS WILL BE SEQUENTIAL WITHIN EACH FLIGHT LINE AND SHALL BE IN THE UPPER RIGHT-HAND CORNER OF THE NEGATIVE IMAGE EDGE TO BE READ AS ONE LOOKS NORTHERLY ALONG THE FLIGHT LINE (OR WESTERLY WHEN LINES ARE EAST-WEST). ALL LETTERING AND NUMBERING OF NEGATIVES SHALL BE APPROXIMATELY 1/5 IN. HIGH AND SHALL RESULT IN EASILY READ, SHARP, AND UNIFORM LETTERS AND NUMBERS. NUMBERING OF NEGATIVES SHALL BE CARRIED OUT USING HEAT-FOIL OR INDELIBLE INK. EACH NEGATIVE SHALL BE PROVIDED WITH THE FOLLOWING ANNOTATION, WHICH SHALL ALSO APPEAR ON THE PRINTS:

- a. YEAR, MONTH, AND DAY OF FLIGHT.
- b. *[USACE PROJECT-SPECIFIC LOCATION/IDENTIFICATION NUMBER].
- c. PHOTO SCALE (RATIO).
- d. FILM ROLL NUMBER.
- e. NEGATIVE NUMBER.

THE DATE OF THE PHOTOGRAPHY SHALL BE IN THE UPPER LEFT CORNER OF EACH FRAME FOLLOWED BY *[USACE PROJECT NUMBER, AND] PHOTO SCALE RATIO. THE FRAME NUMBER WILL BE IN THE UPPER RIGHT-HAND CORNER OF EACH FRAME WITH THE ROLL NUMBER PRINTED 2 IN. TO THE LEFT OF THE FRAME NUMBER.

C.8.9. FILM STORAGE AND DELIVERIES. ALL NEGATIVES AND UNCUT FILM POSITIVES SHALL BE DELIVERED TO THE CONTRACTING OFFICER ON WINDING SPOOLS IN PLASTIC OR METAL CANISTERS. ALL EXTRA AND REJECTED NEGATIVES SHALL BE INCLUDED IN THE ROLL(S). AT LEAST 3 FT OF CLEAR FILM SHALL BE LEFT ON OR SPLICED TO EACH END OF THE ROLL. ALL SPLICES SHALL BE OF A PERMANENT NATURE. EXPOSED AND UNEXPOSED FILM SHALL BE HANDLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. EACH CANISTER SHOULD BE LABELED WITH THE MINIMUM INFORMATION INDICATED BELOW:

- a. NAME AND ADDRESS OF THE CONTRACTING AGENCY.
- b. NAME OF THE PROJECT.
- c. DESIGNATED ROLL NUMBER.
- d. NUMBERS OF THE FIRST AND LAST NUMBERED NEGATIVES OF EACH STRIP.
- e. DATE OF EACH STRIP.
- f. APPROXIMATE SCALE.
- g. FOCAL LENGTH OF LENS IN MILLIMETERS.
- h. NAME AND ADDRESS OF THE CONTRACTOR PERFORMING THE PHOTOGRAPHY.
- i. CONTRACT NUMBER.

C.8.10. *FILM REPORT. A film report shall be included with each project giving the following type of information.

- a. Film number.
- b. Camera type and number, lens number, and filter type and number.
- c. Magazine number or cassette and cassette holder unit numbers.
- d. Film type and manufacturer's emulsion number.
- e. Lens aperture and shutter speed.
- f. Date of photography.
- g. Start and end time for each run in local time.
- h. Negative numbers of all offered photography.
- i. Indicated flying height.

- j. Computed flying height above sea level.
- k. Scale of photography.
- l. Outside air temperature.
- m. Weather conditions: cloud, visibility, turbulence.
- n. Date of processing.
- o. Method of developing.
- p. Developer used and dilution.
- q. Time and temperature of development or film transport speed.
- r. Length of film processed.
- s. General comment on quality.

NOTE: Requirements for submitting the above film processing report are rare and should be required only under special circumstances. Normally, the Flight Log submittal (Paragraph C.5.9) is adequate.

All film submittal and annotation/documentation requirements should be reasonable and necessary. Many of the detailed recordation requirements listed above make sense only for large, areawide mapping projects.

C.9. CONTACT PRINT AND DIAPOSITIVE SPECIFICATIONS.

C.9.1. MATERIAL. ALL CONTACT PRINTS SHALL BE MADE ON AN ELECTRONIC PRINTER ON *[DOUBLE-WEIGHT FIBER-BASED PAPER OR MEDIUM-WEIGHT RESIN-COATED PAPER STOCK] *[other], ON WHICH INK, PENCIL, GREASE PENCIL, AND OTHER COMMONLY EMPLOYED MARKERS CAN BE USED ON BOTH SIDES.

C.9.2. PROCESSING AND QUALITY. THE PROCESSING, INCLUDING EXPOSURE DEVELOPMENT, WASHING, AND DRYING, SHALL RESULT IN FINISHED PHOTOGRAPHIC PRINTS HAVING *[GLOSS] [_____] FINISH, FINE-GRAIN QUALITY, NORMAL UNIFORM DENSITY, AND SUCH COLOR TONE AND DEGREE OF CONTRAST THAT ALL PHOTOGRAPHIC DETAILS OF THE NEGATIVE FROM WHICH THEY ARE PRINTED SHOW CLEARLY IN THE DARK-TONE AREAS AND HIGH-LIGHT AREAS AS WELL AS IN THE HALFTONES BETWEEN THE DARK AND THE HIGH LIGHT. EXCESSIVE VARIANCE IN COLOR TONE OR CONTRAST BETWEEN INDIVIDUAL PRINTS MAY BE CAUSE FOR THEIR REJECTION. ALL PRINTS SHALL BE CLEAR AND FREE OF STAINS, BLEMISHES, UNEVEN SPOTS, AIR BELLS, LIGHT FOG OR STREAKS, CREASES, SCRATCHES, AND OTHER DEFECTS THAT WOULD INTERFERE WITH THEIR USE OR IN ANY WAY DECREASE THEIR USEFULNESS.

C.9.3. TRIMMING. ALL CONTACT PRINTS SHALL BE TRIMMED TO NEAT AND UNIFORM DIMENSIONAL LINES ALONG IMAGE EDGES (WITHOUT LOSS OF IMAGE) LEAVING

DISTINCTLY THE CAMERA FIDUCIAL MARKS. PRINTS LACKING FIDUCIAL MARKS SHALL BE REJECTED.

C.9.4. DELIVERIES. ALL CONTACT PRINTS SHALL BE DELIVERED TO THE CONTRACTING OFFICER IN A SMOOTH, FLAT, AND USABLE CONDITION. THE NUMBER OF CONTACT PRINTS TO BE DELIVERED FOR EACH EXPOSURE IS *[INDICATED IN SECTION B] [_____]. *[ADDITIONAL SETS OF CONTACT PRINTS MAY BE ORDERED AT THE RATES INDICATED IN SECTION B.]

C.9.5. *Preliminary Check Prints. *[Detail requirements, if any.]

C.9.6. *Marked Control Prints. *[Detail requirements, if any.]

C.9.7. DIAPOSITIVE PLATES OR TRANSPARENCIES. ALL BLACK AND WHITE DIAPOSITIVE TRANSPARENCIES USED FOR PHOTOGRAMMETRIC MEASUREMENTS, INCLUDING MAP COMPILATION, SHALL BE EQUAL OR SUPERIOR IN QUALITY TO 0.130-IN.-THICK KODAK AERIAL PLOTTING PLATES OR 0.007-IN.-THICK DUPONT DIAPOSITIVE FILM, NO. CT-7. ALL COLOR DIAPOSITIVE TRANSPARENCIES SHALL BE EQUAL OR SUPERIOR TO KODAK COLOR DIAPOSITIVE FILM, NO. 4109. DIAPOSITIVES *[WILL] [MAY] [WILL NOT] BE DELIVERED TO THE GOVERNMENT FOR INSPECTION AND/OR QUALITY ASSURANCE TESTING. *[DIAPOSITIVES DELIVERED TO THE GOVERNMENT FOR INSPECTION WILL BE RETURNED TO THE CONTRACTOR.]

NOTE: Diapositive film/plates are rarely delivered unless the Government plans to perform quality control/assurance tests on the models, using Government-owned stereoplotters or third-party contractors. This is an option which the Contracting Officer may wish to reserve.

C.10. PHOTOGRAPHIC INDEX REQUIREMENTS.

NOTE: Not all photo mapping projects require photo index maps in the traditional (but costly) style described below. For small projects with few flight lines or frames, a drafted index of photo centers plotted on a USGS quad map will often serve the same functional purpose at far less cost.

C.10.1. GENERAL. THIS ITEM SHALL CONSIST OF ONE OR MORE PHOTOGRAPHIC NEGATIVES, AS NECESSARY, AND PHOTOGRAPHIC PRINT OR PRINTS THEREOF, OF AN ASSEMBLY OF AERIAL PHOTOGRAPHS FORMING AN INDEX OF THE PROJECT AERIAL PHOTOGRAPHY. *[THIS INDEX IS REQUIRED FOR ALL DELIVERIES PLACED UNDER THIS CONTRACT.] COSTS FOR CONTACT PRINTS ARE TO BE INCLUDED IN THE OVERALL UNIT COST OF THE PHOTO INDEX(ES). *[PHOTO INDICES MAY BE COMPILED BY PLOTTING PHOTO CENTERS ON USGS QUADRANGLE MAPS *[_____], ALONG WITH DESCRIPTIVE INFORMATION SPECIFIED BELOW.]

C.10.2. ASSEMBLY. THE PHOTO INDEX SHALL INCLUDE PHOTOGRAPHIC PRINTS MADE FROM ALL NEGATIVES OF THE PHOTOGRAPHY TAKEN AND ACCEPTED FOR THE PROJECT.

THE PRINTS SHALL BE TRIMMED TO A NEAT AND UNIFORM EDGE ALONG THE PHOTOGRAPHIC IMAGE WITHOUT REMOVING THE FIDUCIAL MARKS. THE PHOTOGRAPHS SHALL BE OVERLAP-MATCHED BY CONJUGATE IMAGES ON THE FLIGHT LINE WITH EACH PHOTOGRAPH IDENTIFICATION NUMBER CLEARLY SHOWN. THE PHOTOGRAPHS FOR EACH ADJACENT FLIGHT LINE STRIP SHALL OVERLAP IN THE SAME DIRECTION. AIRBASE LENGTHS SHALL BE AVERAGED IN THE IMAGE MATCHING OF SUCCESSIVE PAIRS OF PHOTOGRAPHS ON FLIGHT LINES, AND ADJOINING FLIGHT LINE ASSEMBLIES SHALL BE ADJUSTED IN LENGTH BY INCREMENTAL MOVEMENT ALONG THE FLIGHT LINE AS NECESSARY.

C.10.3. LABELING AND TITLING. FOR GEOGRAPHIC ORIENTATION, APPROPRIATE NOTATIONS SHALL APPEAR ON THE INDEX, NAMING OR OTHERWISE IDENTIFYING IMPORTANT AND PROMINENT GEOGRAPHIC AND LAND USE FEATURES. ALL OVERLAY LETTERING AND NUMBERING SHALL BE DRAFTING QUALITY. IN ADDITION, A NORTH ARROW, SHEET INDEX, IF APPLICABLE, AND A TITLE BLOCK SHALL APPEAR ON EACH INDEX. THE TITLE BLOCK SHALL CONTAIN PROJECT NAME, CONTRACTOR'S NAME, CONTRACT AGENCY NAME, DATE OF PHOTOGRAPHY, AND AVERAGE SCALE OF PHOTOGRAPHY.

C.10.4. SCALE AND SIZE. THE STAPLED OR TAPED ASSEMBLY OF PHOTOGRAPHY SHALL BE PHOTO-REDUCED TO A SCALE OF ABOUT ONE-THIRD (1/3) OF THE ORIGINAL NEGATIVE SCALE, EXCEPT THAT A LARGER PHOTO INDEX SCALE CAN BE USED IF ALL EXPOSURES FOR ONE PROJECT FIT THE REQUIRED FORMAT ON A SINGLE SHEET. EACH PHOTO INDEX SHEET SHALL BE *[20 BY 24 IN.] [_____] IN SIZE.

C.10.5. *Photographic Copying and Printing. The photo index shall be copied on photographic film so that prints can be made by contact or projection method. The method used shall be the option of the contractor. Whenever the index cannot be copied on one (1) negative, it shall be copied on two (2) or more negatives as necessary.

C.10.6. PROCESSING AND QUALITY. ALL PHOTOGRAPHIC PRINTS OF THE INDEX SHALL COMPLY WITH THE STIPULATIONS GIVEN FOR CONTACT PRINTS IN THIS CONTRACT.

C.10.7. DELIVERIES. *[ONE] [_____] FILM NEGATIVE OR NEGATIVES OF THE PHOTOGRAPHIC INDEX, *[ONE *[Continuous Tone] [specify screen size] SCREENED MYLAR FILM POSITIVE] [AND *[TWO] [_____] PHOTOGRAPHIC PRINTS THEREOF] SHALL BE FURNISHED TO THE CONTRACTING OFFICER *[FOR EACH DELIVERY ORDER UNDER THIS CONTRACT].

C.11. UNCONTROLLED PHOTOGRAPHIC ENLARGEMENTS, AIR PHOTO PLANS, AND PHOTO MOSAICS.

NOTE: Uncontrolled photographic enlargements or air photo plan drawings and photo mosaics are usually prepared from 9- by 9-in. format film. They may also be prepared from film taken by any type of camera—even by a camera held by hand out the window of an aircraft. Photography may be near-vertical or oblique. These types of products are distinguished by the fact that they are "uncontrolled"—that is, no photogrammetric rectification is performed to remove camera nonvertical orientation or vertical relief distortion. The scale of these products is therefore only approximate, and will vary from point to point.

Due to their uncontrolled nature, such products are used only for general feature reference or location. Detailed design or grid coordinate points/lines should not be superimposed on these images except for general reference.

Uncontrolled photographic products may, at times, be more economically procured by using standard purchase order (IFB) methods. They may also be included as line items in A-E IDT contracts when such products are required in addition to controlled line mapping of a particular site/project.

C.11.1 PHOTOGRAPHIC PAPER ENLARGEMENTS. *[BLACK AND WHITE] [COLOR] PHOTOGRAPHIC ENLARGEMENT IS REQUIRED OF THE AREA DESIGNATED *[ON THE ATTACHED MAP] [____]. AERIAL PHOTOGRAPHY SHALL BE *[NEAR-VERTICAL] [OBLIQUE] USING A *[PRECISE AERIAL MAPPING CAMERA] [HAND-HELD TYPE CAMERA]. THE PHOTOGRAPH SHALL BE MOUNTED ON A [____ BY ____]-IN. FORMAT, MOUNTED ON A *[PLYWOOD] [STYROFOAM] [MASONITE] [____] BASE, CONTAINING A [____]- IN. TRIMMED BORDER, A [____] FRAME WITH WALL MOUNTING HARDWARE. A TITLE BLOCK SHALL BE PLACED IN THE [____] CORNER AND CONTAIN THE FOLLOWING DATA: *[_]. *[_] COPIES OF THIS PRODUCT ARE REQUIRED.

C.11.2. UNCONTROLLED AIR PHOTO MAP PLAN SHEETS/DRAWINGS. AIR PHOTO PLAN SHEETS, AT AN APPROXIMATE SCALE OF [____], PROJECTED ON *[F] [____]-SIZE FILM-POSITIVE DRAWING FORMAT, ARE REQUIRED FOR THE AREA DESIGNATED *[ON THE ATTACHED MAP] [____]. A TOTAL OF [____] PHOTO PLAN SHEETS ARE REQUIRED TO COVER THE PROJECT AREA. *THESE SHEETS SHALL BE ORIENTED AND LAID OUT AS SHOWN ON THE ATTACHED MAP. *A [____]-IN. OVERLAP SHALL BE USED BETWEEN SHEETS. NEAR-VERTICAL AERIAL PHOTOGRAPHY TAKEN AT A SCALE OF [____] SHALL BE ENLARGED TO THE REQUIRED DEVELOPMENT SCALE OF THE PHOTO PLAN SHEETS. DRAFTING AND OTHER LABELING DETAILS ARE DESCRIBED ELSEWHERE IN THIS *[CONTRACT] [ORDER]. [____] TRANSPARENCIES ARE REQUIRED FOR EACH SHEET. FILM POSITIVES SHALL BE SCREENED TO [____].

NOTE: Uncontrolled air photo plan overlays are economical products that may be used to show planning developments or contemplated changes in an area. For example, an air photo plan can show the planned location of a proposed structure, canal, highway, etc. They are significantly more economical to obtain than controlled or semicontrolled photographic products, such as orthophotography, and in flat areas will serve the same purpose.

C.11.3. AERIAL MOSAICS. AN ASSEMBLED UNCONTROLLED PHOTO MOSAIC SHALL BE PREPARED AT AN APPROXIMATE SCALE OF [____]. THE MOSAIC SHALL BE ASSEMBLED FROM [____]-SCALE PHOTOGRAPHY, AND ENLARGED/REDUCED AS REQUIRED. THE MOSAIC SHALL BE MOUNTED ON A [____ BY ____]-IN. FORMAT,

MOUNTED ON A *[PAPER] [PLYWOOD] [STYROFOAM] [MASONITE] [_____] BASE, CONTAINING A [_____] -IN. TRIMMED BORDER, A [_____] FRAME WITH WALL MOUNTING HARDWARE. *A FILM *[POSITIVE] [NEGATIVE] OF THE FINAL MOSAIC IS ALSO REQUIRED. MOSAIC ASSEMBLY, MOUNTING, BLENDING, AND OTHER PROCESSES SHALL FOLLOW STANDARD PROCEDURES SET FORTH IN THE MANUAL OF PHOTOGRAMMETRY (REFERENCE C.3.[____]).

NOTE: Add other specifications as required. Aerial mosaics are rarely used in current USACE practice. For most USACE purposes, a single high-altitude photo enlargement is more cost-effective. They are best negotiated on a job/lump sum basis.

C.12. CONTROLLED/RECTIFIED PHOTO PLANS AND ORTHOPHOTOGRAPHY.

NOTE: The process of rectification can be generally defined as the projective transformation of a tilted photograph into one that is tilt-free and of a desired scale. Rectification is accomplished by graphic methods, by analytical computations, or optically and mechanically using an instrument called a rectifier. Orthophotographs are compiled using optical/electronic image scanners.

The need for rectified photo plans (or orthophotographs), as opposed to uncontrolled air photo plans, will depend on the functional requirements of the design/construction project. Most design work is superimposed on line maps, not photo plan enlargements or orthophotos. Thus, the need for expensive orthophoto mapping work must be functionally justified.

An uncontrolled photo plan is far more economical than a controlled/rectified photo, and orthophotographs are significantly more expensive than rectified photography. In relatively flat terrain, the difference between a rectified plan and an orthophotograph is not significant; however, the cost will be. Specifying orthophoto mapping when simple uncontrolled or rectified photography would suffice is a common problem, and can unnecessarily increase project costs. For example, orthophotos would not be necessary for river and harbor project condition surveys—a partially controlled air photo plan enlargement would be adequate. In general, an orthophotograph product should be specified only when design data for large-scale contract plans and specifications will be superimposed on the drawing.

C.12.1. *[CONTROLLED/RECTIFIED] [SEMICONTROLLED] AIR PHOTO MAP PLAN SHEETS/DRAWINGS. RECTIFIED AIR PHOTO PLAN SHEETS, AT AN SCALE OF [_____] , PROJECTED ON *[F] [_____] -SIZE FILM-POSITIVE DRAWING FORMAT,

ARE REQUIRED FOR THE AREA DESIGNATED *[ON THE ATTACHED MAP] [_____] .
A TOTAL OF [_____] RECTIFIED PHOTO PLAN SHEETS ARE REQUIRED TO COVER THE
PROJECT AREA. *THESE SHEETS SHALL BE ORIENTED AND LAID OUT AS SHOWN ON THE
ATTACHED MAP. *A [_____] -IN. OVERLAP SHALL BE USED BETWEEN SHEETS. AERIAL
PHOTOGRAPHY TAKEN AT A SCALE OF [_____] SHALL BE *[GRAPHICALLY]
[ANALYTICALLY] RECTIFIED USING STANDARD OPTICAL-MECHANICAL RECTIFICATION
INSTRUMENTS, AND SHALL BE CONTROLLED BY PHOTO-IDENTIFIABLE *[GROUND SURVEY
CONTROL] [USGS QUAD MAP FEATURES]. FILM POSITIVES SHALL BE SCREENED TO
[_____] . DRAFTING AND OTHER LABELING DETAILS ARE DESCRIBED ELSEWHERE
IN THIS *[CONTRACT] [ORDER]. [_____] TRANSPARENCIES ARE REQUIRED FOR EACH
SHEET. REFERENCE ALSO EM 1110-1-1000.

NOTE: The rectification process requires a visual fit between the photograph and points identifiable either on a map or surveyed ground control points plotted on a manuscript base. When only approximate scale/orientation is needed, a USGS quad map (or other larger scale map) may be used to orient/rectify the photographs. Such a product might be classified as "semicontrolled." This method is far more economical than using ground surveys to control the photos, a controlled product. Plan sheets produced in this way can be printed on normal photographic paper or film positives for subsequent reproduction use. These can be combined with plots of hydrographic/stream cross sections, for example, on the same sheets or on overlays, which can then be overlaid and the two sheets viewed simultaneously on a light table. The semi-rectified or fully rectified photo plan sheet of an area of flat terrain is a very good substitute for a planimetric line map, since it is very nearly to scale. However, the effects of relief displacement have not been removed by the rectification process.

C.12.2. ORTHOPHOTOGRAPHY AND ORTHOPHOTOMAPS.

NOTE: An orthophotograph or orthophotomap is made from an aerial photograph by removing the effects of tilt, relief, lens, and other inherent distortions. Only when relief displacement must be removed is an orthophotograph required. Relief displacement usually need not be removed unless large-scale (e.g., 1 in. = 100 ft or larger) design drawings are involved, and the use of orthophotos as opposed to line maps at these design scales needs to be justified. The use of orthophotography for small-scale (e.g., 1 in. = 200 ft or smaller) general reference maps/charts of relatively flat areas is a costly and often an unnecessary requirement—simple semicontrolled air photo enlargements would suffice. Orthophotography is often called for in specifications when there is no functional engineering or planning requirement for their use.

The guide user should strive to avoid overspecification of photomapping products.

An orthophotomap is almost equivalent to a planimetric line mapping, except for features having sudden, significant elevation changes (e.g., buildings and other like vertical structures). Proposed designs of engineering projects may be directly superimposed on the orthophoto map to detail the understanding of work to be accomplished, primarily for the benefit of laymen not versed in interpreting traditional site plan map products. Orthophotographs are prepared from pairs of overlapping aerial photographs using specially designed orthoplotting instruments. The photographs are oriented in the instrument in the conventional manner for standard stereo photogrammetric mapping. The requirements for ground control or control to be established by aerotriangulation are the same as for photogrammetric mapping. The instrument provides the means of scanning the stereo model to effect corrections for the varying scales caused by topographic relief. The tilt and other distortions are corrected in the orientation of the stereo model. An orthophotomap differs from an orthophotograph in that planimetric and/or topographic detail is added to the scanned photo base.

a. GENERAL. [] SETS OF SCREENED (SCANNED) ORTHOPHOTOGRAPHS [WITH CARTOGRAPHIC FEATURE DETAIL ADDED] [WITH TOPOGRAPHIC CONTOURS SUPERIMPOSED] ARE REQUIRED. THIS ITEM SHALL CONSIST OF AN ORTHOPHOTOGRAPH PHOTOGRAMMETRICALLY AND PHOTOGRAPHICALLY COMPILED FROM ONE PHOTOGRAPH OF A STEREOSCOPIC PAIR. EACH ORTHOPHOTOGRAPH SHALL COMPRISE A PHOTOGRAPHIC PRINTING OF THE PHOTOGRAPHED AREA TO THE BOUNDARIES, QUALITY, AND PRECISION SPECIFIED BY REMOVING THE IMAGE DISPLACEMENTS CAUSED BY GROUND RELIEF AND BY TILT, AND CONTAINING THE IMAGES OF THE GROUND SURFACE AND TOPS OF VEGETATION, BUILDINGS, AND ALL OTHER DETAILS.

b. MATERIALS. ONLY FINE-GRAIN PHOTOGRAPHIC FILM ON A DIMENSIONALLY STABLE BASE SHALL BE USED FOR EXPOSING THE INITIAL NEGATIVE OF EACH ORTHOPHOTOGRAPH AS IT IS COMPILED. OUTDATED FILM SHALL NOT BE USED.

c. EQUIPMENT. THE COMPILATION OF THE ORTHOPHOTOGRAPH SHALL BE ACCOMPLISHED ON AN INSTRUMENT CAPABLE OF MAKING DIRECT ENLARGEMENTS UP TO FOUR (4) DIAMETERS BETWEEN ORIGINAL NEGATIVE SCALE AND COMPILATION SCALE. THIS INSTRUMENT SHALL ALSO BE CAPABLE OF PRODUCING SINGLE OR DOUBLE MODEL ORTHOPHOTOGRAPH NEGATIVES IN SIZES UP TO *[29 BY 34 IN.] [].

d. CONTROL. UNLESS OTHERWISE SPECIFIED, ALL ESSENTIAL BASIC AND SUPPLEMENTAL CONTROL OF REQUIRED ACCURACY SHALL BE OBTAINED BY THE CONTRACTOR FROM AVAILABLE SOURCES, OR PROJECT CONTROL SURVEYS SHALL BE MADE BY THE CONTRACTOR, AS NECESSARY, FOR CONTROLLING THE COMPILATION PRINTING OF THE ORTHOPHOTOGRAPH(S).

e. ACCURACY. PLANIMETRIC FEATURE DETAIL SHOWN ON THE ORTHOPHOTOGRAPH SHALL BE ACCURATE TO THE CRITERIA SPECIFIED IN SECTION C.15 OF THIS CONTRACT.

f. QUALITY. THE PHOTOGRAPHIC NEGATIVE OF THE ORTHOPHOTOGRAPH SHALL HAVE UNIFORM COLOR TONE AND SHALL HAVE THE DEGREE OF CONTRAST TO CAUSE ALL DETAILS TO SHOW CLEARLY IN THE DARK-TONE AREAS AND IN THE HIGH-LIGHT AREAS AS WELL AS IN THE HALFTONES BETWEEN THE DARK AND HIGH LIGHT. IMAGERY SHALL BE FREE FROM DUST MARKS, SCRATCHES, OUT-OF-FOCUS IMAGERY, AND ANY OTHER INCONSISTENCIES IN TONE AND DENSITY BETWEEN INDIVIDUAL ORTHOPHOTOS AND/OR ADJACENT MAP SHEETS. NEGATIVES HAVING EXCESSIVE CONTRAST OR NEGATIVES LOW IN CONTRAST MAY BE REJECTED. EXPOSURE SCAN LINES OR MATCH LINES SHALL NOT EXCEED 0.04 IN., AND SHALL NOT BE NOTICEABLE OR DETRACTING FROM THE PHOTOGRAPHIC DETAILS.

g. CONTOURS. CONTOURS AND SPOT ELEVATIONS *[WILL] [WILL NOT] BE ADDED TO THE ORTHOPHOTOGRAPHS THROUGH THE PLOTTING SYSTEM PROVIDED IN THE ANALYTICAL ORTHOPLOTTERS OR BY RESETTING THE ORIGINAL STEREOMODELS AND COMPILING THE CONTOURS INTO A TRANSPARENT OVERLAY REGISTERED TO THE ORTHOPHOTOGRAPHS. THE OVERLAY MUST BE A STABLE POLYESTER WITH A MINIMUM THICKNESS OF 0.004 IN., REGISTERED PRECISELY WITH THE ORTHOPHOTOGRAPH BASE. WHEN THE CONTOURS ARE TO BE PHOTOGRAPHICALLY COMBINED INTO THE ORTHOPHOTOGRAPH BASE, A CHOICE MUST BE MADE BETWEEN BLACK OR WHITE LINES, BASED ON THE PREDOMINANT TONE IN THE AREA.

h. SCREENING. FINAL REPRODUCIBLE SHEETS SHALL BE *[continuous-tone] [halftone] [____] SCREENED POSITIVES ON POLYESTER BASE WITH A MINIMUM THICKNESS OF 0.004 IN. *SCREENING SHALL BE *[120] [____] LINES PER INCH. *FOR COMPOSITE ORTHOPHOTO AND CONTOUR REPRODUCIBLES, ONLY THE PHOTOGRAPHIC IMAGE SHALL BE HALFTONE SCREENED.

NOTE: The contours may be photographically combined into the orthophoto map, and may be shown as either white or black lines. The selection is made to effect the greatest contrast considering the predominant tone of the work area. Cartographic symbolization, contour numbers, spot elevations, border, and title information can be compiled and reproduced in the photo laboratory.

i. DELIVERIES. ALL MATERIALS, INCLUDING THE ORTHOPHOTOGRAPH NEGATIVE(S), THE CONTROL PRINTS, AND THE DIAPOSITIVES SHALL BE FURNISHED TO THE CONTRACTING OFFICER.

C.13. GROUND PHOTO CONTROL SURVEY REQUIREMENTS.

C.13.1. GENERAL. ALL HORIZONTAL AND VERTICAL CONTROL SURVEYS REQUIRED FOR PHOTOGRAMMETRIC MAPPING SHALL, UNLESS OTHERWISE INDICATED HEREIN, BE PERFORMED USING PROCEDURES AND/OR ACCURACY STANDARDS CONSISTENT WITH PROFESSIONAL SURVEYING PRACTICES. ALL SURVEYING AND PHOTO MAPPING WORK SHALL BE REFERENCED TO EXISTING PROJECT CONTROL, WHICH IS ON NAD *[27] [83] (HORIZONTAL DATUM) AND *[NGVD 29] [NAVD 88] [_____] (VERTICAL DATUM). THE LOCAL GRID REFERENCE SYSTEM SHALL BE *[SPCS 27 ZONE _____] [SPCS 83 ZONE _____] [UTM ZONE _____]

[other]. ALL GRID COORDINATES SHOWN ON MAP PRODUCTS SHALL BE EXPRESSED IN, OR CONVERTED TO, *[US SURVEY FEET] [INTERNATIONAL FEET] [METERS]. THE CONTRACTOR SHALL PROVIDE SURVEY CREWS WITH PROFESSIONAL SURVEY PERSONNEL AND EQUIPMENT CAPABLE OF PERFORMING OBSERVATIONS AND MEASUREMENTS THAT MEET THE REQUIRED ACCURACY NEEDED FOR THE WORK. ALL FIELD OBSERVATIONAL DATA SHALL BE PERFORMED IN ACCORDANCE WITH STANDARD ENGINEERING SURVEY PRACTICES, *[AS SPECIFIED IN REFERENCE *C.3.*[___]]. SURVEY DATA SHALL BE RECORDED IN BOUND SURVEY BOOKS WHICH WILL SUBSEQUENTLY BE DELIVERED TO THE GOVERNMENT. ALL SURVEY WORK WILL BE PERFORMED UNDER THE SUPERVISION AND CONTROL OF A LICENSED PROFESSIONAL LAND SURVEYOR. *[ALL SURVEY WORK, INCLUDING OFFICE COMPUTATIONS AND ADJUSTMENTS, IS SUBJECT TO GOVERNMENT REVIEW AND APPROVAL FOR CONFORMANCE WITH PRESCRIBED ACCURACY STANDARDS.]

NOTE: The above clause should reference the particular survey procedural manual that should be followed in performing conventional engineering surveying, including note keeping and record keeping requirements. This reference may be a District manual, Technical Manual, EM, or other recognized standard.

C.13.2. PHOTO CONTROL SURVEYS. SURVEYS PERFORMED TO CONTROL HORIZONTAL OR VERTICAL LOCATIONS OF POINTS USED IN CONTROLLING STEREOSCOPIC MODELS SHALL BE PERFORMED USING RECOGNIZED ENGINEERING AND CONSTRUCTION CONTROL SURVEY METHODS, AS NECESSARY TO MEET THE ULTIMATE MAPPING STANDARDS REQUIRED IN PARAGRAPH C.15. THIS USUALLY REQUIRES, AT MINIMUM, THIRD-ORDER PROCEDURES PERFORMED RELATIVE TO EXISTING NETWORK OR PROJECT CONTROL, USING STANDARD ENGINEERING SURVEY TRAVERSE, DIFFERENTIAL LEVELING, GPS, OR ELECTRONIC TOTAL STATION MEASUREMENT TECHNIQUES.

a. UNLESS OTHERWISE INDICATED, PHOTO CONTROL POINTS OR PANELLED POINTS MAY BE TEMPORARILY MARKED (2- by 2-IN. STAKES, NAILS, ETC.). THESE TEMPORARY MARKS SHOULD REMAIN IN PLACE FOR AT LEAST THE DURATION OF THE CONTRACT, AND MAY BE USED FOR PERFORMING QUALITY CONTROL OR ASSURANCE SURVEYS.

b. EXISTING PROJECT/NETWORK CONTROL. A TABULATION AND/OR DESCRIPTION OF EXISTING PROJECT/NETWORK CONTROL POINTS *[IS SHOWN BELOW] [IS SHOWN IN ATTACHMENT G] [WILL BE PROVIDED WITH EACH DELIVERY ORDER]. THE SOURCE AGENCY, COORDINATES, DATUM, AND ESTIMATED ACCURACY OF EACH POINT IS INDICATED ON THE DESCRIPTION. PRIOR TO USING ANY CONTROL POINTS, THE MONUMENTS SHOULD BE CHECKED TO ENSURE THAT THEY HAVE NOT BEEN MOVED OR DISTURBED.

NOTE: List each existing control station(s) or, alternately, refer to a map, tabulation attachment, and/or descriptions that would be attached at contract Section G.

c. *The contractor shall perform surveys connecting existing project control to assure that such control has sufficient relative accuracy to control the overall project. Should these surveys indicate deficiencies in the existing control, the contractor shall advise the Contracting Officer, and

appropriate modification may be made to the contract to perform resurveys of the existing network.

d. All horizontal and vertical control points will be occupied as a station within a closed traverse or closed level loop. If it is not possible to occupy an individual control point or photo target, thus requiring spur shots, all angles shall be read at least three times and averaged, and all distances measured twice and averaged.

NOTE: The following clauses would be used only when permanent project control monuments need to be established for future design or construction work, when existing control is found to be deficient, when existing project control is distant from the project site necessitating extensive traversing or leveling work, or when there is no existing project control. Procedural methods for horizontal or vertical control extension should follow either USACE Command standards or FGCC criteria, which should be referenced/attached to the contract, and specifically noted for each type of work. FGCC standards are intended for national geodetic network densification and would normally be used only if no other local standards are available.

Therefore, there is no need to reiterate basic surveying techniques, procedures, methods, standards, etc., in the contract. Few USACE mapping or construction projects require X-Y or Z relative accuracies in excess of those obtainable by Third-order methods/standards. Specifying higher levels of accuracy must be thoroughly justified relative to the impact on relative mapping accuracies and other factors. Refer also to the guidance contained in EM 1110-1-1000.

C.13.3. *New station monumentation, marking, and other control requirements. Permanently monumented control stations shall be surveyed as at the locations shown in the attachment in Section G. *[Note specific locations where permanent control points are required.] A total of [___] horizontal points and [___] vertical points are required.

C.13.4. *Horizontal accuracy requirements. New or permanent control monuments/stations shall be established to a *[Third] [_____] -order, Class *[I] [___] relative accuracy classification, or 1 part in *[10,000] [_____] . *Supplemental control stations shall be established to a *[Third] [_____] -order, Class *[II] [___] relative accuracy classification, or 1 part in *[5,000] [_____] . See Reference C.3.*[___] .

C.13.5. *Vertical accuracy requirements. New or permanent vertical control shall be performed to *[Third] [_____] -order standards. See Reference C.3.*[___] .

a. *All stations shall be monumented in accordance with EM 1110-1-1002, Survey Markers and Monumentation. Monumentation for this project shall be Type *[_] for horizontal and Type *[_] for vertical per EM 1110-1-1002 criteria. *[Monumentation shall be defined to include the required reference marks and azimuth marks required by EM 1110-1-1002.]

NOTE: Deviations from EM 1110-1-1002 should be indicated as required. USACE project control rarely requires supplemental reference/azimuth marks—the optional specification clauses below should be tailored accordingly.

b. *At each station, angle and distance measurements shall be made between a network station and reference marks/azimuth marks established in accordance with the requirements set forth in EM 1110-1-1002. All observations shall be recorded in a standard field book.

(1) *For reference marks, two (2) directional positions are required (reject limit ± 10 - second arc) and with steel taping performed to the nearest ± 0.01 ft.

(2) *Four directional positions are required to azimuth marks. The reject limit for a 1-second theodolite is ± 5 seconds. Azimuth mark landmarks shall be easily defined/described natural features or structures of sufficient distance to maintain a *[_]-second angular accuracy. *[_]-order astronomic azimuths shall be observed to azimuth marks.]

(3) *A compass reading shall be taken at each station to reference monuments and azimuth marks.

C.13.6. *Station Description and Recovery Requirements.

a. *Station descriptions and/or recovery notes shall be written in accordance with the instructions contained in EM 1110-1-1002. [Form *[_] shall be used for these descriptions.] Descriptions shall be *[written] [typed].

b. *Descriptions *[are] [are not] required for *[existing] [and/or newly established] stations.

c. *Recovery notes *[are] [are not] required for existing stations.

d. *A project control sketch *[is] [is not] required.

C.13.7. PREMARKED PHOTO CONTROL TARGETS. UNLESS OTHERWISE SPECIFIED HEREIN *[OR IN DELIVERY ORDER INSTRUCTIONS], ALL GROUND CONTROL USED AS PHOTOGRAPHIC CONTROL POINTS UNDER THIS CONTRACT WILL BE PREMARKED PRIOR TO OBTAINING AERIAL PHOTOGRAPHY. TARGETS SHALL BE OF ADEQUATE SIZE AND PROVIDE GOOD PHOTOGRAPHIC CONTRAST SO THEY WILL BE CLEARLY DISTINCT IN STEREOSCOPIC MODELS. PANELS WILL BE MADE USING COLORED FABRIC (UNBLEACHED MUSLIN), PLASTIC, OR IN SOME INSTANCES, PAINT ON ROADS. THE COLOR TO BE USED SHOULD BE IN SHARP CONTRAST TO THE BACKGROUND AREA, I.E., BLACK ON A WHITE BACKGROUND, ETC. PANELS

ARE IN THE FORM OF CROSSES, T'S, V'S, OR Y'S. THE LONG DIMENSION OF THE PANEL SHOULD BE A MINIMUM OF 0.015 OF THE NEGATIVE SCALE IN FEET. FOR PHOTOGRAPHS AT A SCALE OF 1 IN. = 500 FT, THIS WOULD BE 7.5 FT. THE MINIMUM WIDTH SHOULD BE 0.01 OF THE PHOTO SCALE IN INCHES. LARGER TARGETS WILL BE MORE EASILY VISIBLE, WHILE ANYTHING SMALLER MAY NOT BE SEEN ON THE PHOTOGRAPHS. THE CONTROL POINT IS LOCATED DIRECTLY UNDER THE CENTER OF THE CROSS OR THE INTERSECTION OF THE LINES OF THE T OR V, AND MAY BE MARKED IN A TEMPORARY MANNER. THE PANELS SHOULD BE SECURED TO THE GROUND.

NOTE: The location of the photo control points on the photography should be selected by the contractor, either by designation of an area in which a specific control point should be obtained or by actually identifying the point on the photograph. The former method is to be preferred since the surveyor should be required to make the most reliable selection in the field. For small mapping projects, or where good judgment and economy dictate, photo control should be obtained for each of the stereo models to be used in the mapping. An ideal situation requires at least three horizontal and four vertical photo control points for each stereo model. Refer also to EM 1110-1-1000.

C.13.8. *Full Photo Model Control. The contractor shall establish a minimum of *[three (3)] [_____] (____)] horizontal and *[four (4)] [_____] (____)] vertical control points for each stereoscopic model by field survey methods. The horizontal points shall be as far apart as feasible within each model. Each point shall be an image of an existing object or be a finite photographic pattern that is clearly identifiable both on the ground and on the photographs, or be the photographic target. The vertical points shall be spaced for optimum use of the model, preferably in or near each corner of the model. The accuracy of all supplemental control surveys shall be the same as that stipulated for all control surveys required under this contract. Where pretargeting is to be utilized, sufficient targets must be established so that each model contains the specified number of control points, even though the starting point of flight lines may shift from the intended position.

NOTE: The above clause is used in instances when analytical aerotriangulation extension methods are not used. Aerotriangulation is a method of extending and increasing the density of photo control. It may be performed using a precision type stereoplotting instrument; when so performed it is called "bridging" or "stereotriangulation." Aerotriangulation also may be accomplished by mathematical computational routines, called "analytical phototriangulation." Aerotriangulation is used most successfully on large projects, on jobs where existing basic control is found at each end of a mapping area, or when the requirements of the job do not include the

establishment of ground control points within the mapping area. When two or more adjacent flight lines are involved, a block system of aerotriangulation is used. Analytical aerotriangulation bridging techniques are especially applicable to small-scale mapping work covering relatively large areas. For large-scale site plan mapping of relatively small areas (i.e., only one or two models may be involved), which are intended for detailed design, use of analytical aerotriangulation bridging techniques should be limited; sufficient ground photo control should be set to cover each model within the project. As with all phases of mapping work, the decision to use full ground photo control or aerotriangulation bridging is a function of the project requirements and resources available. See also guidance contained in EM 1110-1-1000.

C.13.9. CONTROL PHOTOGRAPHS. ALL HORIZONTAL AND VERTICAL CONTROL POINTS INCLUDING SUPPLEMENTAL CONTROL POINTS SHALL BE MARKED AND LABELED WITH APPROPRIATE POINT IDENTIFICATION NUMBERS. ALL CONTROL POINTS NOT PREMARKED SHALL BE NEATLY PIN-PRICKED AND CLEARLY IDENTIFIED AND BRIEFLY DESCRIBED ON THE BACK OF THE PHOTOGRAPH. *[COORDINATES AND BRIEF DESCRIPTIONS OF MARKED CONTROL POINTS SHALL BE WRITTEN ON THE BACK OF EACH PHOTO.] (FULL STATION DESCRIPTIONS WILL BE WRITTEN FOR NEWLY SET, PERMANENTLY MONUMENTED POINTS.) THE MARKED-UP CONTROL PRINTS *[WILL] [WILL NOT] BE DELIVERED TO THE GOVERNMENT.

C.13.10. FIELD TOPOGRAPHIC SURVEY DENSIFICATION. CONSISTENT WITH THE PLANIMETRIC FEATURE, TOPOGRAPHIC, AND UTILITY DETAILING REQUIREMENTS CONTAINED IN PARAGRAPH C.14, ADDITIONAL DETAIL SURVEYS BY *[PLANE TABLE] [TOTAL STATION] METHODS SHALL BE PERFORMED AS NECESSARY TO ASSURE MAPPING COVERAGE.

NOTE: Add here any requirements for highway/stream sections, overbank surveys, hydrographic surveys, FEMA/Flood Insurance Study sections, etc.

C.13.11. FIELD CLASSIFICATION AND MAP EDIT SURVEYS. FIELD CLASSIFICATION, INSPECTION, AND/OR EDIT SURVEYS *[WILL] [WILL NOT] BE PERFORMED *[ON THIS PROJECT] [AS REQUIRED IN THE SCOPE OF DELIVERY ORDERS]. A *[TWO] [_____] -MAN SURVEY CREW WILL PERFORM SURVEYS NECESSARY TO CLASSIFY CULTURAL FEATURES, CLARIFY OBSCURED DETAIL; ADD TO OR CORRECT INCOMPLETE, CRITICAL FEATURE, OR TOPOGRAPHIC DETAIL BY CONVENTIONAL FIELD SURVEY METHODS; AND PERFORM MAP STANDARD INTERNAL QUALITY CONTROL TESTING AS REQUIRED BY THE CONTRACTOR.

NOTE: Field inspection of manuscripts is often necessary in order to fill in details required by the specifications that may have been obscured on the aerial photography or are too small to be recognized on the photographs. The project's functional

requirement will dictate the need for and scope of subsequent field classification/edit surveys. For map scales of 1:2,400 and smaller, the field edit takes the form of classification of data. This might include names of landmark buildings, highways, trails, cemeteries, identification of major features, and similar general data. Occasionally, classification surveys can be made before the maps are compiled, and it is desirable to use enlarged photographs for this purpose. For maps of larger scales, particularly 1 in. = 60 ft and larger, the field edit becomes an essential part of the mapping process. Since large-scale maps are used for the design of engineering projects, complete map details are essential. In urban areas, parked cars may hide manholes and catch basins; invert elevations or other underground utility data may be required; utility poles and outlets should be checked and identified; property corners and the names of owners should be provided; and trees and bushes and such other details as may be needed by the map user should be identified. For this purpose, prints of the manuscript map should be used in the field. The field notations must be neat and legible. Field classification work may entail use of a plane table, total station, level, etc., to perform the work. Typically, a fully equipped two-man survey crew can perform this work.

C.13.12. *FINAL MAP QUALITY ASSURANCE TEST SURVEYS. THE CONTRACTOR WILL FIELD A *[TWO] [_____] -MAN SURVEY CREW TO PERFORM QUALITY ASSURANCE TESTS IN ACCORDANCE WITH THE CRITERIA CONTAINED IN SECTION C.15 OF THIS CONTRACT. THESE TEST SURVEYS *[MAY] [SHALL] BE CONDUCTED WITH A GOVERNMENT REPRESENTATIVE PRESENT.

C.14. STEREOCOMPILATION, DRAFTING, AND CADD SPECIFICATIONS.

C.14.1. ANALYTICAL AEROTRIANGULATION SPECIFICATIONS. WHEN AUTHORIZED WITHIN THIS CONTRACT *[AND/OR DELIVERY ORDER], THE X-, Y-, AND Z-COORDINATES FOR SUPPLEMENTAL PHOTO CONTROL POINTS MAY BE DERIVED USING FULLY ANALYTICAL, SIMULTANEOUS BLOCK AEROTRIANGULATION ADJUSTMENT METHODS. INDUSTRY-STANDARD ADJUSTMENT SOFTWARE, OR THAT SUPPLIED WITH ANALYTICAL PLOTTERS, MUST BE USED TO PERFORM THE COMPUTATIONS. USE OF DIFFERENT ALTITUDE PHOTOGRAPHY IS NOT ALLOWED—THE PHOTOGRAPHY SPECIFIED IN PARAGRAPH C.6 SHALL BE USED TO PERFORM ALL MEASUREMENTS.

a. EQUIPMENT. THE PHOTOGRAMMETRIC MENSURATION INSTRUMENTS SHALL HAVE SUFFICIENT ACCURACY AND UTILITY FOR MEASURING THE X AND Y PHOTOGRAPHIC COORDINATES OF THE FIDUCIAL OR OTHER PHOTOGRAPHIC REFERENCE MARKS, TARGETS, PHOTOGRAPHIC IMAGES, AND ARTIFICIALLY MARKED POINTS TO ACHIEVE THE REQUIRED ACCURACIES.

b. GROUND AND SUPPLEMENTAL CONTROL REQUIREMENTS AND EXTENSION LIMITS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE OPTIMUM LOCATION, QUALITY, AND ACCURACY OF ALL GROUND SURVEYED CONTROL POINTS USED FOR

CONTROLLING THE AEROTRIANGULATION ADJUSTMENT. UNLESS OTHERWISE SPECIFIED, THERE SHALL BE AT LEAST ONE (1) GROUND VERTICAL CONTROL POINT FOR EVERY *[TWO (2)] [_____] (____)] STEREOSCOPIC MODELS AND ONE (1) GROUND HORIZONTAL CONTROL POINT FOR EVERY *[FOUR (4)] [_____] (____)] STEREOSCOPIC MODELS. AT LEAST SIX PHOTO CONTROL POINTS MUST APPEAR ON EACH STEREO MODEL. SUPPLEMENTAL POINTS INCLUDE A POINT NEAR THE PRINCIPAL POINT OF EACH PHOTO WITH THE OTHER FOUR (4) POINTS LOCATED NEAR EACH CORNER OF THE MODEL, PREFERABLY IN THE OVERLAP AREA BETWEEN ADJACENT MODELS AND STRIPS. A GROUND CONTROL POINT MAY BE SUBSTITUTED FOR A SUPPLEMENTARY CONTROL POINT IF IT IS LOCATED IN THE SAME GENERAL AREA OF ONE OF SIX (6) POSITIONS DESCRIBED HEREIN. UNLESS OTHERWISE DIRECTED, ALL SUPPLEMENTAL CONTROL POINTS WILL BE PHYSICALLY DRILLED (PUGGED) ON THE AERIAL PHOTO.

c. RESULTANT ACCURACY OF AEROTRIANGULATION ADJUSTMENT. FOR CLASS 1 MAPS, THE ROOT MEAN SQUARE (RMS) ERROR FOR THE X-, Y-, AND Z-COORDINATES OF ALL SUPPLEMENTAL CONTROL POINTS DETERMINED BY ANALYTICAL AEROTRIANGULATION SHALL NOT BE IN ERROR BY MORE THAN *[1:10,000] [_____] IN HORIZONTAL POSITION (X AND Y) AND *[1:8,000] [_____] IN ELEVATION (Z), WHEN EXPRESSED AS A RATIO FRACTION OF THE FLYING HEIGHT. THESE ADJUSTMENT STATISTICS MUST BE CLEARLY IDENTIFIED ON THE ADJUSTMENT SOFTWARE OUTPUT THAT SHALL BE DELIVERED TO THE GOVERNMENT *[PRIOR TO COMMENCEMENT OF STEREO PLOTTING]. A SHORT WRITTEN REPORT *[SUBMITTED TO THE CONTRACTING OFFICER PRIOR TO COMPILATION] EXPLAINING ANY ANALYTICAL CONTROL PROBLEMS ENCOUNTERED SHALL ACCOMPANY THIS PRINTOUT. AEROTRIANGULATION ACCURACY CRITERIA FOR OTHER MAP CLASSES ARE CONTAINED IN EM 1110-1-1000.

d. CONTROL PRINTS. THE IMAGE OF ALL GROUND CONTROL AND SUPPLEMENTAL CONTROL POINTS SHALL BE APPROPRIATELY MARKED AND IDENTIFIED ON A SET OF CONTACT PRINTS. THE IDENTIFYING NUMBER FOR EACH SUPPLEMENTAL CONTROL POINT SHALL BE RELATED TO THE PHOTOGRAPH ON WHICH IT APPEARS.

e. DELIVERIES. ALL MATERIALS, INCLUDING THE X-Y-Z COORDINATE LISTING OF SUPPLEMENTAL CONTROL POINTS, FINAL ADJUSTMENT COMPUTATIONS WITH ERROR OF CLOSURE, CONTROL PRINTS *[THE MARKED/DRILLED DIAPOSITIVES], AND ANY

ROLLS-FILM NEGATIVES USED BY THE CONTRACTOR, SHALL BE PROVIDED TO THE GOVERNMENT.

C.14.2. STEREOPLOTTER SPECIFICATIONS. TOPOGRAPHIC AND/OR PLANIMETRIC FEATURE LINE MAPS ARE TO BE DEVELOPED/GENERATED ON AN ANALYTICAL STEREOPLOTTER OF SIMILAR OR EQUAL DESIGN TO THAT OF A *[Wild_____,] *[Zeiss_____,] *[Kern_____,] [specify plotter/model]. THE PLOTTER MUST BE CAPABLE OF AUTOMATICALLY PERFORMING/ADJUSTING INTERIOR, RELATIVE, AND ABSOLUTE ORIENTATIONS, AND OUTPUT STATISTICAL DATA THEREOF, AND GENERATING DIGITAL DATA OF OBSERVED TOPOGRAPHIC/FEATURE INFORMATION INTO SPATIAL LAYERS DIRECTLY COMPATIBLE WITH TWO-DIMENSIONAL/THREE-DIMENSIONAL DESIGN FILE CRITERIA (STANDARDS MANUAL FOR USACE COMPUTER-AIDED DESIGN AND DRAFTING (CADD) SYSTEMS EM 1110-1-1807 (REFERENCE C.3.[____])). *[PREVIOUS GENERATION OPTICAL-MECHANICAL TRAIN STEREOPLOTTERS, OF SIMILAR OR EQUAL DESIGN TO A *[Wild A-10], MAY BE USED WHEN UPGRADED OR MODIFIED FOR DIRECT DIGITAL DATA OUTPUT.] *Stereoplotter operators should have demonstrated experience on the machine and in the type of terrain being compiled.

NOTE: All map compilation under this guide is intended to be performed using high-accuracy analytical stereoplotters. With provision, an older analog, opticaltrain, "first-order" type stereoplotter may be substituted. Under some circumstances, such as small-scale mapping, use of analog plotters may be allowed. Direct digital output is a requirement unless excepted. Production levels, and thus unit costs in Section B, will be a function of the plotter used; therefore, unit prices should be based on a specific instrument or instruments. Since the guide user will specify photo-negative scale, final mapping target scale, and the type of stereoplotter to be used for each project/ order, there should be no conflict over plotter capabilities, C-factors, etc.

C.14.3. MAP COMPILATION SCALE. THE CONTRACTOR SHALL FURNISH TO THE CONTRACTING OFFICER STEREOPLOTTER-DERIVED *[MANUSCRIPTS] [AND/OR FINISHED MAPS] AT A SCALE OF 1 IN. = *[_____] FT, OR AS INDICATED IN SECTION H ATTACHMENTS.

C.14.4. MANUSCRIPT PLOTTING MEDIA. *[MANUSCRIPTS DRAFTED DIRECTLY FROM THE STEREOPLOTTER SHALL BE PLOTTED IN *[PENCIL] [INK] [BALLPOINT PEN] ON *[PAPER] [HIGH-GRADE, STABLE BASE MYLAR NOT LESS THAN 0.004-IN. IN THICKNESS] ON STANDARD *[F] [____]-SIZE SHEETS.]

NOTE: The manuscript map is the initial medium in the preparation of the final map. In some instances, it is the final product delivered to the map user. In order to preserve the accuracy standards of the photogrammetric process, the manuscript (the original) map must be drawn on a stable base material (polyester sheets, Dupont Mylar, or equal are recommended).

Experience indicates that the manuscript sheets should be cut from the manufacturer's rolls and allowed to "season" in the atmosphere of the map compilation area. For analytical plotters, a variety of map preparation phases exist. The manuscript phase may be generated after stereocompilation, with preliminary editing and drafting performed on a CADD work station independent of the stereoplotter.

C.14.5. MODEL SETUP AND ORIENTATION DATA. ANALYTICAL PLOTTER ORIENTATION PARAMETERS AND STATISTICAL OUTPUTS FOR EACH MODEL SETUP SHALL BE SUBMITTED WITH EACH PROJECT. THESE SHEETS SHALL BE FULLY ANNOTATED BY DATE, TIME, OPERATOR NAME, COMPILATION DATES/TIMES, PHOTO NUMBERS, AND OTHER DATA THAT CONFIRM THAT THE MAPPING WAS COMPILED FROM THE REQUIRED NEGATIVE SCALE.

NOTE: Receipt of these computer printouts is a partial QA check that the work was compiled from the required negative scale using established photo control. It is not necessarily a 100 percent assurance against a contractor using bootleg higher-altitude photography and/or USGS quad maps for control, a far too common practice in the past when photogrammetric mapping was obtained by other than competitively negotiated A-E contracting methods.

C.14.6. PLANIMETRIC FEATURE DATA DETAILING. THE MAPS SHALL CONTAIN ALL THE PLANIMETRIC FEATURES VISIBLE OR IDENTIFIABLE ON OR INTERPRETABLE FROM THE AERIAL PHOTOGRAPHS, AND COMPATIBLE WITH TYPE OF PROJECT INVOLVED (I.E., MILITARY MASTER PLANNING, DETAILED SITE PLAN MAPPING, ETC.) THESE SHALL INCLUDE, BUT NOT BE LIMITED TO, BUILDINGS, ROADS, FARM LANES, TRAILS, DRIVEWAYS, SIDEWALKS, CATCH BASINS, RIVERS, SHORELINES, DITCHES, DRAINAGE LINES, EROSION AREAS, PONDS, MARSHES, LAKES, RESERVOIRS, RAILROADS, FENCE LINES, POWER POLES, PIPELINES, WOODED AREAS, TIMBER LINES, TREE CLUMPS, ORCHARDS, VINEYARDS, INDIVIDUAL TREES THAT CAN BE RECOGNIZED AS SUCH, BRIDGES, CULVERTS, PIERS, SPILLWAYS, TUNNELS, DAMS, ROCK OUTCROPS, QUARRIES, RECREATION AREAS, CEMETERIES, *[_], ETC. *[LEVEL OF DETAIL REQUIRED FOR EACH PROJECT WILL BE PROVIDED IN DETAILED SPECIFICATIONS FOR THE WORK ORDER.] REFER ALSO TO EM 1110-1-1000.

a. *Features such as quarries, gravel pits, log piles, coal piles, sand piles, slag piles, open pit mines, etc., shall be shown by symbols identified in USGS Photogrammetric Compilation Symbols -- Chapter 3F1, Preliminary Edition, March 1981, unless otherwise specified.

b. *Surface utility data. Locate and identify all utilities such as culverts (pipes or box drains); water systems including valves and meters; catch basins; manholes (storm, sanitary, telephone, gas, and electric); meter/valve boxes; overhead electrical pole location and type; low wire elevations; towers; and transformers. Except in urban or heavy industrial areas, locate only main trunk aerial and surface lines; identify size and capacities and measure invert elevations as applicable to project. Obtain ground photographs

as designated. *[Specify controlling limits and/or elevations within which utility details are required.]

c. *Underground utilities. For designated subsurface utilities, provide pipe/conduit alignment, type, size, nomenclature, depth below surface, junction points, etc.; obtain top and invert elevations of all [_____].

d. *Highways, roads, and streets. Obtain names, descriptions, classifications; center-line profiles or sections as designated; route classification; pavement width and construction.

e. *Railroads. Obtain names, locations (and stationing) of mile-posts, bridges, culverts, semaphores, culverts, yard limits, etc. Obtain center-line profiles or sections as designated.

f. *Bridges and culverts greater than [_____] ft wide. Measure deck, flow line, and clearance elevations; horizontal clearances between abutments and piers, if any; and width of piers. Include detailed plan and elevation sketches; ground photographs upstream and downstream with lens axis normal to opening; names or other designations of structures; abutment/pier materials, condition, etc.

g. *Buildings and other structures. Obtain proper names of all buildings or landmarks; proper names, installation numbering, and/or descriptions of all buildings and other structures affected or possibly affected by the project; foundation and first-floor elevations of those structures within designated limits and/or elevations below [_____] ft; basement elevations; sewer/drain outlet information below elevation [_____] ft; and ground photographs of buildings and structures.

h. *Boundary and right-of-way data. Locate all right-of-way markers/monuments for existing roads/projects/structures. Connect any prominent property corners, installation boundaries, or section corners encountered.

i. *Vegetation. Obtain general identification and description of clusters, as would be of interest in preliminary value appraisals or in clearing operations.

j. *[Requirements for overlay (layer) sheets.]

NOTE: Describe any special requirements for overlay drawings, e.g., sanitary, storm, electrical, mechanical, etc. Add to and elaborate on any of the above instructions on feature detail or utility data that may be critical to the particular project, especially if relocation work is to be performed. Specify any sectors within the map where planimetric/utility feature detail is especially important, or where it may be deemphasized. Since most of the above items will be obtained by ground survey forces, they could represent a sizable cost in an overall mapping project. Therefore, precise specifications and scope are

critical for this portion of the work, and the functional need for each item must be carefully considered—in particular, underground utility surveys. The amount of ground detail required may also determine whether photogrammetric methods are cost-effective, or if the full project should be mapped using ground survey methods (plane table, total station, etc.).

C.14.7. TOPOGRAPHIC DATA DETAILING. THE MAP SHALL CONTAIN ALL REPRESENTABLE AND SPECIFIED TOPOGRAPHIC FEATURES VISIBLE OR IDENTIFIABLE ON OR INTERPRETABLE FROM THE AERIAL PHOTOGRAPHY. TOPOGRAPHIC DATA MAY BE GENERATED BY *[CONTOUR TRACING] OR *[DIGITAL TERRAIN MODELING] TECHNIQUES.

a. CONTOUR TRACKING/TRACING. *[THE CONTOUR INTERVAL FOR THIS PROJECT IS _____ FT.] EACH CONTOUR SHALL BE DRAWN SHARP AND CLEAR AS A SOLID LINE, EXCEPT THROUGH DENSELY WOODED AREAS WHERE THE GROUND CANNOT BE SEEN AND WHERE IT IS OBSCURED BY AN OVERHANGING BLUFF OR LEDGE. IN SUCH GROUND HIDDEN PLACES, THE CONTOURS SHALL BE SHOWN AS DASHED (BROKEN) LINES. EVERY *[FIFTH] [_____] CONTOUR (INDEX CONTOUR) SHALL BE ACCENTUATED AS A HEAVIER LINE THAN THE INTERMEDIATE FOUR AND SHALL BE NUMBERED ACCORDING TO ITS ACTUAL ELEVATION ABOVE MEAN SEA LEVEL. WHENEVER INDEX CONTOURS ARE CLOSER THAN ONE-QUARTER (1/4) INCH, AND THE GROUND SLOPE IS UNIFORM, THE INTERMEDIATE FOUR MAY BE OMITTED.

(1) *[HALF-INTERVAL CONTOURS SHALL BE ADDED IN ALL SIZEABLE FLAT AREAS WHERE GENERAL SLOPES ARE 1 PERCENT OR LESS.] LABELING OR NUMBERING OF CONTOURS SHALL BE PLACED SO THAT THE ELEVATION IS READILY DISCERNABLE. LABELING OF INTERMEDIATE CONTOURS MAY BE REQUIRED IN AREAS OF LOW RELIEF.

(2) THE TURNING POINTS OF CONTOURS THAT DEFINE DRAINAGE CHANNELS, DITCHES, RAPIDS, FALLS, DAMS, SWAMPS, SLOUGHS, ETC., SHALL BE CONSISTENT IN DEPICTING THE CORRECT ALIGNMENT OF THE CHANNEL AND IN REFLECTING THE CONTINUATION OF THE DRAINAGE.

(3) PARTICULAR CARE MUST BE TAKEN TO SHOW THE OUTLINE OF SHORELINES OR OTHER WATER LIMITS AT THE TIME PHOTOGRAPHY IS TAKEN. WHERE THE WATER DEMARKATION LINE CANNOT BE DEFINITELY ESTABLISHED, THE APPROXIMATE POSITION SHALL BE SHOWN BY A BROKEN LINE SO AS TO INDICATE THE CONTINUITY OF DRAINAGE.

b. DIGITAL TERRAIN MODEL (DTM) GENERATION. DIGITAL ELEVATION MODELS (DEM) SHALL BE GENERATED ON A PRESET GRID INTERVAL OF *[_____] FT C/C, AS TRACKED AUTOMATICALLY IN THE ANALYTICAL PLOTTER, OR ON A NETWORK OF RANDOM POINTS SUPPLEMENTED WITH BREAK-LINE POINTS TO PROPERLY ESTABLISH THE HYPGOMETRY OF THE TERRAIN. INTERMEDIATE BREAKS, HIGHS, LOWS, ETC., ARE ADDED INDEPENDENTLY. CONTOURS WILL BE GENERATED OFF-LINE USING STANDARD DTM/CADD SOFTWARE.

NOTE: With the automated scanning features on analytical plotters, systematic DTM/DEM topographic generation may prove more efficient than conventional tracing of individual contours. Contours can later be

generated from triangulated irregular network (TIN)
models created from the DTM/DEM.

c. SPOT ELEVATIONS. SPOT ELEVATIONS DETERMINED PHOTOGRAM-
METRICALLY SHALL BE SHOWN ON THE MAPS IN PROPER POSITION AT WATER LEVEL ON THE
SHORELINE OF LAKES, RESERVOIRS, PONDS, AND THE LIKE; ON HILLTOPS; IN SADDLES;
AT THE BOTTOM OF DEPRESSIONS; AT INTERSECTIONS AND ALONG CENTER LINES OF WELL
TRAVELED ROADS; AT PRINCIPAL STREETS IN CITIES, RAILROADS, LEVEES, AND HIGH-
WAYS; AT TOPS AND BOTTOMS OF VERTICAL WALLS AND OTHER STRUCTURES; AND AT
CENTER LINE OF END OF BRIDGES. IN AREAS WHERE THE CONTOURS ARE MORE THAN *[3]
[] IN. APART AT MAP SCALE, SPOT ELEVATIONS SHALL ALSO BE SHOWN AND THE
HORIZONTAL DISTANCE BETWEEN THE CONTOURS AND SUCH SPOT ELEVATIONS OR BETWEEN
THE SPOT ELEVATIONS SHALL NOT EXCEED *[2] [] IN. AT SCALE OF DELIV-
ERED MAPS. SPOT ELEVATIONS SHALL BE MEASURED TO THE []-ON 1-FT CONTOUR
DRAWINGS THEY SHALL BE SHOWN TO THE 0.1-FT LEVEL.

d. *WHEN THE CONTRACT STIPULATES THE DELINEATION OF SPECIFIED
FEATURES (PLANIMETRY AND CONTOURS) REGARDLESS OF WHETHER SUCH FEATURES ARE
VISIBLE FROM OR OBSCURED ON THE AERIAL PHOTOGRAPHY AND ON STEREOSCOPIC MODELS
FORMED THEREFROM, THE CONTRACTOR SHALL COMPLETE COMPILATION OF THE REQUIRED
MAPS BY FIELD SURVEYS ON THE GROUND.

e. DASHED CONTOURS. WHEN THE GROUND IS OBSCURED BY VEGETATION TO
THE DEGREE THAT STANDARD ACCURACY IS NOT OBTAINABLE, *[CONTOURS SHALL BE SHOWN
BY DASHED LINES] [FIELD SURVEY TOPOGRAPHIC DENSIFICATION SHALL BE PERFORMED]
[]].

C.14.8. MANUSCRIPT DRAFTING. ALL DRAFTING ON THE MANUSCRIPTS SHALL BE
SUFFICIENTLY NEAT AND COMPLETE AS TO ELIMINATE OR MINIMIZE ERRORS OF MISINTER-
PRETATION ON THE PART OF THE SCRIBER AND/OR DRAFTSMAN PREPARING THE FINISHED
LINE MAPS. MANUSCRIPT DRAFTING SHALL BE SUFFICIENTLY DARK AND ADEQUATELY
EDITED SO AS TO AFFORD GOOD AND USABLE PRINTS, IF REQUIRED. EITHER PENCIL OR
INK MAY BE USED.

NOTE: The above requirement may not be applicable to
analytical plotters where the manuscript is effective-
ly the digital database and is displayed on a work-
station monitor. Manuscript copies may be used for
performing quality control/assurance surveys.

C.14.9. COMPILATION HISTORY. A COMPILATION HISTORY (MODEL DIAGRAM OR
MODEL SETUP SHEET) SHALL BE PREPARED FOR EACH STEREOSCOPIC MODEL USED TO
ACCOMPLISH THE MAPPING. HISTORY SHALL INCLUDE BUT NOT BE LIMITED TO THE FINAL
PHOTOGRAPHIC FIT TO X-, Y-, AND Z-COORDINATES OF GROUND AND SUPPLEMENTAL CON-
TROL POINTS AND ANY OTHER PROBLEMS ENCOUNTERED IN THE MODEL ORIENTATION AND
COMPILATION PROCESS. HISTORY SHALL ALSO INCLUDE THE PROJECT NAME, FLIGHT
DATE, PHOTO SCALE, MAP SCALE, STEREOPLOTTER USED, AND THE OPERATOR NAME.

NOTE: With the completion of the map compilation by
the plotter operator, a thorough review and edit shall

be made before final drafting. This element of quality control is designed to check for discernible errors (unusual topographic features can be checked by examining the contact prints stereoscopically); to ensure that the manuscript map (or workstation viewed database) is conventional and consistent in expression; that the user's specifications have been followed (designated mapping limits, symbols, amount and type of details shown, names, format and content); that ties have been made and referenced to adjacent sheets; that control has been labeled; and that the manuscript (or digital database) is complete with respect to content and appearance.

C.14.10. FINAL SITE PLAN MAPS AND/OR DIGITAL DATA BASE CONTENTS.

a. COORDINATE GRID. UNLESS OTHERWISE SPECIFIED, GRID TICKS OF THE APPLICABLE STATE PLANE COORDINATE SYSTEM (SPCS) *[UNIVERSAL TRANSVERSE MERCATOR (UTM) SHALL BE PROPERLY ANNOTATED AT THE TOP AND RIGHT EDGE OF EACH MANUSCRIPT SHEET. SPACING OF THE GRID TICKS SHALL BE APPROXIMATELY FIVE (5) IN. *[THE SPCS TO BE USED FOR THIS PROJECT IS _____.] *[Specify SPCS/UTM and local zone, if applicable.]

b. CONTROL. ALL HORIZONTAL AND VERTICAL GROUND CONTROL AND ALL SUPPLEMENTAL CONTROL DETERMINED BY EITHER FIELD OR AEROTRIANGULATION METHODS SHALL BE SHOWN ON THE MAP/MANUSCRIPT. *[All control points should be plotted to an accuracy of ± 0.005 mm.]

c. SHEET LAYOUT AND MATCH LINES. THE *[CONTRACTOR SHALL DESIGN] [GOVERNMENT WILL PROVIDE] THE SHEET LAYOUT THAT PROVIDES OPTIMUM COVERAGE OF THE PROJECT. MATCH LINES SHALL BE PROVIDED AND PROPERLY LABELED SO THAT EACH SHEET MAY BE JOINED ACCURATELY TO ADJACENT SHEETS. (SEE *[DISTRICT] DRAFTING STANDARDS SPECIFIED IN SECTION *[C.3.____] OF THIS CONTRACT.)

d. SYMBOLS AND NAMES. THE SYMBOLS TO BE USED FOR MAJOR PLANIMETRIC AND TOPOGRAPHIC FEATURES SHALL BE IN ACCORDANCE WITH SYMBOLS PROVIDED IN REFERENCE *[C.3.____]. THE NAMES OF CITIES, TOWNS, VILLAGES, RIVERS, STREAMS, ROADS, STREETS, HIGHWAYS, AND OTHER FEATURES OF IMPORTANCE SHALL BE OBTAINED BY THE CONTRACTOR. ALL NAMES AND NUMBERS SHALL BE LEGIBLE AND CLEAR IN MEANING AND SHALL NOT INTERFERE WITH MAP FEATURES. NAMES OF TOWNS, RIVERS, STREAMS, ETC., WILL GENERALLY BE THOSE APPEARING ON THE EXISTING USGS, DEFENSE MAPPING AGENCY (DMA), OR STATE HIGHWAY PUBLISHED MAPS. *[THE US BOARD OF GEOGRAPHICAL NAMES MAY ALSO BE CONSULTED.]

e. TITLE AND SHEET INDEX. A TITLE SHALL BE PLACED ON EACH MAP MANUSCRIPT TO THE SIZE AND ARRANGEMENT DIRECTED BY THE CONTRACTING OFFICER, AND SHALL INCLUDE THE NAME OF THE CONTRACTING AGENCY, THE PROJECT NAME, THE DATE OF PHOTOGRAPHY USED, THE STRIP AND PHOTOGRAPH NUMBERS, THE MAP SCALE, THE DATE OF THE MAPPING, MANUSCRIPT NUMBER, AND THE NAME OF THE CONTRACTOR. IF MORE THAN ONE (1) MANUSCRIPT/MAP SHEET IS PREPARED, A SMALL-SCALE SHEET INDEX SHALL BE DRAWN ON EACH MANUSCRIPT/MAP SHEET SHOWING THE POSITION AND THE RELATIONSHIP OF ALL MAP SHEETS TO EACH OTHER. THE TITLE BLOCK CONTENTS *[AND SHEET INDEX REQUIREMENTS] FOR FINISHED MAPS WILL BE FURNISHED BY THE

CONTRACTING OFFICER. *THE CONTRACTOR'S NAME/ADDRESS, CONTRACT/DELIVERY ORDER NUMBER, AND LOGO WILL BE PLACED ON EACH MAP SHEET. *[Add applicable professional certification requirements.]

f. VERTICAL DATUM. UNLESS OTHERWISE SPECIFIED, ELEVATIONS ARE BASED ON NGVD 29.

C.14.11. FINAL PLOTTING MEDIA. THE FINISHED LINE MAPS SHALL BE *[SCRIBED AND PHOTOGRAPHICALLY PRINTED IN FILM POSITIVE FORMAT] [DRAFTED IN INK] [ELECTROSTATICALLY PRINTED FROM THE CADD DATABASE] ON STANDARD *[F] [____]-SIZE [____ - BY ____-IN.] DIMENSIONALLY STABLE, STATIC-FREE POLYESTER DRAFTING FILM (E.G., MYLAR), OF AT LEAST 0.004-IN. THICKNESS. *FILM POSITIVE DRAWINGS MADE FROM SCRIBESHEETS SHALL BE SCREENED AT *[____]. *THE MAP BORDER WILL NOT EXCEED [____ BY ____] IN. AND THE SHEET WILL BE ORIENTED NORTH-SOUTH, UNLESS OTHERWISE SPECIFIED. LOCATIONS OF TITLE BLOCKS, REVISION BLOCKS, BORDER DETAIL, LINE WEIGHTS, ETC., ARE CONTAINED IN REFERENCE *[C.3.____]. *[MASTER BORDERED FORMAT SHEETS WILL BE PROVIDED BY THE GOVERNMENT FOR CONTRACTOR REPRODUCTION.]

C.14.12. DRAFTING AND SCRIBING QUALITY. THE PROFESSIONAL STANDARDS OF DRAFTSMANSHIP AND SCRIBING SHALL BE MAINTAINED THROUGHOUT THE MAPPING PROCESS. ALL SYMBOLS, LINES, LETTERS, AND NUMBERS SHALL BE CLEAR AND LEGIBLE AND CONFORM WITH THE *[DISTRICT] DRAFTING STANDARDS SPECIFIED IN REFERENCE *[C.3.____].

C.14.13. MAP EDITING. ALL MAP PRODUCTS WILL BE REVIEWED BY AN EXPERIENCED EDITOR DURING APPLICABLE STAGES OF PRODUCTION.

NOTE: The amount of time required for office map editing and review will vary with the project type, scope, and topographic/planimetric feature complexity. Not all projects require extensive editing. This line item is separate from field classification surveys or field edit work, which may also be required after initial manuscript compilation.

C.14.14. DIGITAL DATA DESIGN FILE SUBMITTALS.

a. PRODUCTS. DIGITAL DATA PRODUCTS TO BE FURNISHED BY THE CONTRACTOR SHALL INCLUDE, BUT NOT BE LIMITED TO, TOPOGRAPHIC DRAWINGS, CROSS SECTIONS, PROFILES, AND DIGITAL ELEVATION/TERRAIN MODELS.

b. ACCURACIES. THE HORIZONTAL AND VERTICAL ACCURACIES FOR DIGITAL PRODUCTS SHALL BE AS STIPULATED IN SECTION C.15 OF THIS CONTRACT.

c. FORMAT. THE COMPLETED DRAWINGS, DIGITAL FILES, ETC., SHALL BE FULLY OPERATIONAL, BY TRANSLATION OR OTHER PROCESS, ON THE *[INTERGRAPH] [AUTOCAD] [_____] OPERATING SYSTEM UTILIZED BY THE [_____] DISTRICT AT THE TIME THE DRAWINGS ARE DELIVERED. PRESENT OPERATING SYSTEM IS *[INTERGRAPH IGDS 8.8.2, VMS 5.0] [AUTOCAD VERSION 10] [_____] (SEE ALSO USACE CADD STANDARDS, REFERENCE *[C.3.____].)

*[THE MAPPING DATABASE WILL BE COMPATIBLE WITH USGS DIGITAL LINE GRAPH, LEVEL 3 FORMAT.]

NOTE: Add any specific layer or file requirements, such as contour string limits, unique layer requirements, and data translation or transfer standards. Add project-specific deviations from the Corps CADD standards (EM 1110-1-1807). Include also any requirements for file translation or transfer with/between specific GIS, LIS, AM/FM systems.

d. ALL DESIGN FILES, INCLUDING DRAWINGS AND/OR MODELS, SHALL BE FURNISHED ON *[9-TRACK MAGNETIC TAPE CERTIFIED AS 1600 OR 6250 BPI] [MAGNETIC DISK] [other]. HIGH-DENSITY 5-1/4" OR 3-1/2 IN. FLOPPY DISKETTES FORMATTED FOR MS-DOS MAY BE USED. THE CONTRACTOR SHALL FURNISH A COPY OF THE CELL LIBRARY USED IN PREPARING THESE DRAWINGS AND COMPILATION HISTORY AS DESCRIBED ABOVE. ALL DATA SHALL BECOME THE PROPERTY OF THE GOVERNMENT UPON SUBMITTAL.

C.14.15. DELIVERIES. ALL COMPLETED MANUSCRIPTS, MAPS, AND ANY REPRODUCTIONS THEREOF, DIAPOSITIVES, MODEL DIAGRAMS, COMPILATION HISTORIES, AND DIGITAL DATA SHALL BE DELIVERED TO THE CONTRACTING OFFICER IN ACCORDANCE WITH WORK ORDER REQUIREMENTS.

C.15. QUALITY CONTROL AND QUALITY ASSURANCE STANDARDS.

C.15.1. CONTRACTOR QUALITY CONTROL.

a. GENERAL. ALL PHOTOGRAMMETRIC MAPPING DATA SUBMITTED UNDER THIS CONTRACT SHALL CONFORM TO THE ACCURACY STANDARDS OUTLINED IN EM 1110-1-1000 UNLESS MODIFIED OR SUPPLEMENTED BELOW. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INTERNAL QUALITY CONTROL FUNCTIONS INVOLVED WITH FIELD SURVEYING, PHOTOGRAPHY AND LABORATORY PROCESSING, STEREOCOMPILATION, DRAFTING, FIELD CHECKING, AND EDITING OF THE PHOTOGRAMMETRICALLY MADE MEASUREMENTS AND COMPILED MAPS TO ASCERTAIN THEIR COMPLETENESS AND ACCURACY. ALSO, THE CONTRACTOR SHALL MAKE THE ADDITIONS AND CORRECTIONS NECESSARY TO COMPLETE THE MAPS AND PHOTOGRAMMETRICALLY MADE MEASUREMENTS.

b. MATERIALS. ALL MATERIALS, SUPPLIES, OR ARTICLES REQUIRED FOR WORK THAT ARE NOT COVERED HEREIN, OR BY WORK ORDER SPECIFICATIONS, SHALL BE STANDARD PRODUCTS OF REPUTABLE MANUFACTURERS AND ENTIRELY SUITABLE FOR THE INTENDED PURPOSE. UNLESS OTHERWISE SPECIFIED, THEY SHALL BE NEW, UNUSED, AND SUBJECT TO THE APPROVAL OF THE CONTRACTING OFFICER.

NOTE: One of the following map accuracy standards shall be specified by the guide user and the others deleted. Alternatively, the standards set forth in EM 1110-1-1000 may be used and simply referenced in this contract. The ASPRS standard is recommended for USACE large-scale mapping work.

C.15.2. *NATIONAL MAP ACCURACY STANDARDS (LARGE-SCALE MAPS). Unless specified otherwise, all photogrammetric mapping will meet the following horizontal and vertical accuracy requirements for scales of 40, 50, 100, 200, and 400 ft to 1-in.

a. Contours. Not more than 10 percent of the elevations tested shall be in error more than one-half contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement of $1/30$ in.

b. Planimetric features. Not more than 10 percent of well-defined points or features tested shall be in error by more than one-thirtieth ($1/30$) of an inch, measured at the map/manuscript publication scale. Well-defined features are those that may be plotted within $1/100$ in. at the map/manuscript scale.

C.15.3. *DEPARTMENT OF TRANSPORTATION REFERENCE GUIDE OUTLINE ACCURACY SPECIFICATIONS (LARGE-SCALE MAPPING). Unless specified otherwise, all photogrammetric mapping will meet the following horizontal and vertical accuracy requirements for scales of 40, 50, 100, 200, and 400 ft to 1 in.

a. Contours. Ninety percent of the elevations determined from the solid-line contours of the topographic maps shall have an accuracy with respect to true elevation of one-half ($1/2$) contour interval or better and the remaining 10 percent of such elevations shall not be in error by more than one contour interval.

b. Coordinate grid lines. The plotted position of each plane coordinate grid line shall not vary by more than one-hundredth ($1/100$) of an inch from true grid value on each map manuscript.

c. Horizontal control. Each horizontal control point shall be plotted on the map manuscript within the coordinate grid in which it should lie to an accuracy of one-hundredth ($1/100$) of an inch of its true position as expressed by the plane coordinates computed for the point.

d. Planimetric features. Ninety percent of all planimetric features that are well-defined on the photographs shall be plotted so that their position on the finished maps shall be accurate to within at least $1/40$ in. of their true coordinate position, as determined by the test surveys. None of the features tested shall be misplaced on the finished maps by more than $1/20$ in. from their true coordinate position.

e. Special requirements. When stipulated in the contract or delivery order scope of work, all specified features shall be delineated on the maps, regardless of whether they can be seen on the aerial photographs and on stereoscopic models formed therefrom. The contractor shall complete compilation by conventional field surveys on the ground so as to comply with all accuracy and completeness stipulations.

f. Spot elevations. Ninety percent of all spot elevations placed on the maps shall have an accuracy of at least one-fourth the contour interval, and the remaining 10 percent shall not be in error by more than one-half the contour interval.

C.15.4. *ASPRS ACCURACY STANDARDS FOR LARGE-SCALE MAPS.

a. Vertical accuracy. Vertical map accuracy is defined as the 1-sigma (RMS) error in elevation in terms of the project's evaluation datum for well-defined points only. The limiting RMS error shall be one-third (1/3) the contour interval for well-defined points and one-sixth the indicated contour interval for spot heights placed on the map/manuscript. The map position of the ground point may be shifted in any direction by an amount equal to twice the limiting RMS error in position (defined below). Statistical tests shall be made in accordance with ASPRS procedures.

b. Horizontal accuracy. Horizontal map accuracy is defined as the 1-sigma RMS error in terms of the project's planimetric survey coordinates (x-y) for checked well-defined points as determined by full (ground) scale of the map/manuscript. The limiting RMS errors in x or y (feet) for each scale (in feet/inch) are as follows:

Error <u>ft</u>	Scale <u>ft/in.</u>
0.2	20
0.3	30
0.4	40
0.5	50
1.0	100
2.0	200
4.0	400

c. Blunders. Discrepancies between the x-, y-, or z-coordinates of the ground point, as determined from the map by the check survey, that exceed three (3) times the limiting RMS error shall be interpreted as blunders and will be corrected.

C.15.5. *FEMA FLOOD INSURANCE STUDY ACCURACY REQUIREMENTS. For photogrammetric surveys performed in support of FEMA flood insurance studies, the following standards shall be met. Detailed specifications and quality control standards are found in Appendix 4 of Reference C.3.*[__].

a. Contours. The contour interval shall be 4 ft. Ninety percent of the elevations determined from the solid-line contours of the topographic maps shall have an accuracy with respect to true elevation of one-half (1/2) contour interval or better and the remaining 10 percent of such elevations shall not be in error by more than one contour interval.

b. Coordinate grid lines (if used). The plotted position of each plane coordinate grid line shall not vary by more than 1/100 in. from true grid value on each map.

c. Horizontal control. Each horizontal control point shall be plotted on the map manuscript within the coordinate grid in which it should lie to an accuracy of 1/100 in. of its true position as expressed by the plane coordinates computed for the point. Should noncoordinate control procedures be utilized, the same accuracy shall pertain to the plotting of any type of control points.

NOTE: For FEMA work, horizontal photo control may be adequately effected by scaling coordinates from USGS 1:24,000-scale quad maps, provided no degradation to the critical vertical component results. Absolute accuracy required in the vertical is ± 0.5 ft.

d. Planimetric features. Ninety percent of all planimetric features that are well-defined on the photographs shall be plotted so that their position on the maps shall be accurate to within at least 0.025 in. of their true coordinate position. None of the features shall be misplaced on the maps by more than 1/20 in. from their true coordinate position. When map production is accomplished without benefit of a grid coordinate system, then the accuracy shall be interpreted as the distance between any two well-defined points.

C.15.6. USACE PHOTOGRAMMETRIC MAPPING ACCURACY STANDARDS. UNLESS SPECIFIED OTHERWISE, ALL PHOTOGRAMMETRIC MAPPING WILL MEET THE HORIZONTAL AND VERTICAL ACCURACY REQUIREMENTS SPECIFIED FOR CLASS *[_] MAPPING, IN CHAPTER 2 OF EM 1110-1-1000.

C.15.7. *SMALL-SCALE ACCURACY REQUIREMENTS. FOR LINE MAPS OF SCALES SMALLER THAN 1 IN. PER 400 FT (1:4,800), THE UNITED STATES NATIONAL MAP ACCURACY STANDARDS (REFERENCE C.3.[_]) SHALL BE FOLLOWED.

C.15.8. METHODS FOR EVALUATING MAP ACCURACY. ALL MAPS COMPILED SHALL BE SUBJECT TO MAP TESTING BY THE GOVERNMENT, BY INDEPENDENT THIRD-PARTY FORCES, OR BY CONTRACTOR FORCES WORKING UNDER DIRECT GOVERNMENT REVIEW, TO ENSURE THAT THEY COMPLY WITH THE APPLICABLE ACCURACY REQUIREMENTS LISTED ABOVE. THE MAP TEST RESULTS WILL BE STATISTICALLY EVALUATED RELATIVE TO THE DEFINED ACCURACY CRITERIA, AND PASS/FAIL DETERMINATION MADE ACCORDINGLY. THE DECISION OF WHETHER OR NOT TO PERFORM RIGID MAP TESTING ON ANY PROJECT, DELIVERY ORDER, OR PORTION OF A PROJECT RESTS WITH THE CONTRACTING OFFICER. IN ALL CASES, THE CONTRACTOR WILL BE ADVISED IN WRITING WHEN SUCH ACTION WILL BE TAKEN.

NOTE: For fixed-scope contracts, indicate herein the degree of formal map testing contemplated, and by whom. If performed by contractor survey forces, then adequate field survey time must be allocated in Section B. On IDT contracts, formal map accuracy tests are optional for each delivery order. The need for map tests is a function of the ultimate or intended use of the maps. For large-scale site plan mapping, being intended for detailed foundation design, map testing is critical, as well as for maps containing critical utility and drainage detail. However, map testing would not be as necessary for general, smaller scale map products on which no design effort is foreseen. Master plan mapping might fall in this category. The availability of Government survey resources to perform the testing must also be considered. If

contractor forces are needed to perform the tests, then a Government representative must be present to select test points and review the actual field observations. A separate A-E contractor may also be selected to perform such work. Given the resources involved in performing map testing, the costs of such efforts must not be disproportionate to the overall photogrammetric mapping effort—the benefits of photogrammetric mapping over conventional plane table or total station survey methods might be eliminated.

a. OFFICE AND FIELD CHECKS. THE PARTY RESPONSIBLE FOR MAP TESTING MAY, DURING THE COURSE OF THE PROJECT, INSPECT MAP COMPILATION IN THE CONTRACTOR'S FACILITY BY COMPARISON WITH AERIAL PHOTOGRAPHS. HOWEVER, THE FINAL MAP COMPILATION SHALL BE CHECKED BY FIELD INSPECTION AND A HORIZONTAL AND VERTICAL ACCURACY CHECK BY CONVENTIONAL FIELD SURVEY CHECKS, USING TRAVERSE, TRIANGULATION, AND DIFFERENTIAL LEVELING METHODS TO TEST SELECTED POINTS OR FEATURES ON THE COMPLETED DRAWINGS.

b. TEST PROFILES FOR TOPOGRAPHY. IN ORDER TO CHECK FOR COMPLIANCE WITH THE VERTICAL CONTOUR ACCURACY REQUIREMENTS, TEST PROFILE TRAVERSES SHALL BE MADE IN THE FIELD. PROFILES TO CHECK CONTOURS AND SPOT ELEVATIONS SHOULD BE AT LEAST FIVE (5) IN. LONG AT THE MAP SCALE, AND SHOULD CROSS AT LEAST TEN (10) CONTOUR LINES. PROFILES SHOULD START AND CLOSE UPON MAP FEATURES OR PREVIOUSLY ESTABLISHED CONTROL POINTS. IN FLAT AREAS AND AT PRINCIPAL ROAD AND RAIL INTERSECTIONS, SPOT ELEVATIONS SHALL BE CHECKED. IN GENERAL, ONE PROFILE *[PER MAP SHEET] [PER *[3] [_____] STEREO MODELS] IS SUFFICIENT.

c. SPOT ELEVATION TESTS. TESTING FOR VERTICAL ACCURACY MAY ALSO BE PERFORMED BY COMPARING THE ELEVATIONS AT WELL-DEFINED POINTS AS DETERMINED FROM THE MAP TO CORRESPONDING ELEVATIONS DETERMINED BY A SURVEY OF HIGHER ACCURACY. A MINIMUM OF 20 POINTS SHALL BE CHECKED AND SHALL BE DISTRIBUTED THROUGHOUT THE SHEET, OR CONCENTRATED IN CRITICAL AREAS.

d. TEST POINTS FOR PLANIMETRIC FEATURES. THE ACCURACY OF THE PLANIMETRIC MAP FEATURE COMPILATION SHALL BE TESTED BY COMPARING THE GROUND COORDINATES (X AND Y) OF AT LEAST 20 POINTS (WELL-DEFINED MAP FEATURES) PER TEST PER MAP SHEET, AS DETERMINED FROM MEASUREMENTS ON THE MAP AT PUBLICATION SCALE, TO THOSE FOR THE SAME POINTS, AS PROVIDED BY A CHECK SURVEY OF HIGHER ACCURACY. THE CHECK SURVEY SHALL HAVE AN ORDER OF ACCURACY EQUAL TO OR EXCEEDING THAT SPECIFIED FOR ESTABLISHING THE MAPPING CONTROL. MAPS WILL ALSO BE EXAMINED FOR ERRORS AND/OR OMISSIONS IN DEFINING FEATURES, STRUCTURES, UTILITIES, AND OTHER NOMENCLATURE, OR FOR TOTAL GAPS IN COMPILATION/COVERAGE. THE MINIMUM OF 20 POINTS SHALL BE DISTRIBUTED THROUGHOUT THE SHEET OR CONCENTRATED IN CRITICAL AREAS.

e. SELECTION OF WELL-DEFINED TEST POINTS. THE TERM "WELL-DEFINED MAP FEATURES" PERTAINS TO FEATURES THAT CAN BE SHARPLY DEFINED AS DISCRETE POINTS. POINTS THAT ARE NOT WELL-DEFINED ARE EXCLUDED FROM THE ACCURACY TEST. THE SELECTION OF WELL-DEFINED POINTS SHALL BE MADE THROUGH AGREEMENT BETWEEN THE CONTRACTING OFFICER AND THE CONTRACTOR. GENERALLY, IT MAY BE MORE DESIRABLE TO DISTRIBUTE THE POINTS MORE DENSELY IN THE VICINITY OF IMPORTANT

STRUCTURES OR DRAINAGE FEATURES AND MORE SPARSELY IN AREAS THAT ARE OF LESSER INTEREST. FURTHER DEFINITIONS AND REQUIREMENTS FOR SELECTION OF WELL-DEFINED PHOTO/MAP POINTS ARE FOUND IN THE REFERENCE STANDARD USED. THE LOCATIONS AND NUMBERS OF MAP TEST POINTS AND/OR TEST PROFILES SHALL BE MUTUALLY AGREED TO BY THE CONTRACTOR AND CONTRACTING OFFICER'S REPRESENTATIVE (COR).

C.15.9. CORRECTION OF UNSATISFACTORY WORK. FAILURE TO MEET MAP TEST CRITERIA WILL REQUIRE RECOMPILATION OF THE PROJECT AT THE CONTRACTOR'S EXPENSE. WHEN A SERIES OF SHEETS ARE INVOLVED IN A MAPPING PROJECT, THE EXISTENCE OF ERRORS (I.E., MAP TEST FAILURE) ON ANY INDIVIDUAL SHEET WILL CONSTITUTE PRIMA FACIE EVIDENCE OF DEFICIENCIES THROUGHOUT THE PROJECT (I.E., ALL OTHER SHEETS ARE ASSUMED TO HAVE SIMILAR DEFICIENCIES), AND FIELD MAP TESTING WILL CEASE. AFTER CORRECTION OF THE WORK, THE CONTRACTOR WILL BE RESPONSIBLE FOR PAYMENT OF MAP TESTING REQUIRED ON THE CORRECTED DRAWINGS. WHEN SUCH EFFORTS ARE PERFORMED BY GOVERNMENT SURVEY FORCES, THESE COSTS WILL BE DEDUCTED FROM CONTRACT/DELIVERY ORDER PAYMENT ESTIMATES.

NOTE: The purpose of the above clause is to preclude the Government from performing contractor quality control functions to the extent that the map testing effort becomes a field classification/edit function. However, the Government COR must exercise reasonable judgment in assessing map test results, given the fact that no map is perfect and minor errors or omissions can be expected. For this reason, the specification writer must clearly define critical parameters in the scope of work in order for the contractor to ensure quality control is performed in these areas. For instance, if top of curb elevations are important, these should be emphasized in the scope. Conveying such information is best accomplished by clearly noting the intended functional/project use of the maps in the scope (e.g., foundation design, spillway design, runway construction, general installation masterplanning, etc.). With such information, the contractor can concentrate his resources on the more critical feature elements and not spend undue time on feature detail superfluous to the design/construction effort.

C.16. NONTOPOGRAPHIC PHOTOGRAMMETRY SPECIFICATIONS.

NOTE: Specifications for close-range photogrammetric measurements on structures or mechanical devices should be developed from or referenced to the Manual of Photogrammetry.

C.17. SUBMITTAL REQUIREMENTS.

C.17.1. SUBMITTAL SCHEDULE. THE COMPLETED WORK, MAPS, AND REPORTS SHALL BE DELIVERED WITHIN *[_ DAYS AFTER NOTICE TO PROCEED IS ISSUED] *[BY calendar date].

NOTE: Include a more detailed submittal schedule breakdown if applicable to project. Note any preliminary, priority, or partial delivery requirements, with reference to specific Section B line items.

C.17.2. PACKAGING AND MARKING. PACKAGING OF COMPLETED WORK SHALL BE ACCOMPLISHED SUCH THAT THE MATERIALS WILL BE PROTECTED FROM HANDLING DAMAGE. EACH PACKAGE SHALL CONTAIN A TRANSMITTAL LETTER OR SHIPPING FORM, IN DUPLICATE, LISTING THE MATERIALS BEING TRANSMITTED, BEING PROPERLY NUMBERED, DATED, AND SIGNED. SHIPPING LABELS SHALL BE MARKED AS FOLLOWS:

U.S. ARMY ENGINEER DISTRICT, _____
ATTN: _____
*[include office symbol and name]
CONTRACT NO. _____
*[DELIVERY ORDER NO. _____]
[STREET/PO BOX] _____
*[complete local mailing address]

*HAND-CARRIED SUBMISSIONS SHALL BE PACKAGED AND MARKED AS ABOVE, AND DELIVERED TO THE FOLLOWING OFFICE ADDRESS:

*[insert office/room number as required]

NOTE: In this section, also reference any unique data transmittal/submittal requirements for digital data, if applicable.

C.18. PROGRESS SCHEDULES AND WRITTEN REPORTS.

C.18.1. *PREWORK CONFERENCE.

NOTE: Detail any requirements for a prework conference after contract award, including requirements for preparing written reports for such conferences.

SECTION D

CONTRACT ADMINISTRATION DATA

SECTION E

SPECIAL CONTRACT REQUIREMENTS

SECTION F

CONTRACT CLAUSES

NOTE: See instructions in Appendix B of PARC IL 92-4.

SECTION G

LIST OF ATTACHMENTS

G.1. U.S. ARMY CORPS OF ENGINEERS EM 1110-1-1000, PHOTOGRAMMETRIC MAPPING.
THIS REFERENCE IS ATTACHED TO AND MADE PART OF THIS CONTRACT.

NOTE: List any other attachments called for in contract Section C or in other contract sections. This may include such items as:

a. Marked-up project sketches/drawings.

b. Station/Monument descriptions or Recovery Notes.

c. Drafting standards.

d. CADD standards.

SECTION H

REPRESENTATIONS, CERTIFICATIONS, AND OTHER
STATEMENTS OF OFFERERS

SECTION I

INSTRUCTIONS, CONDITIONS, AND NOTICES TO OFFERERS

NOTE: See PARC IL 92-4 for guidance in preparing these
clauses/provisions.
